NUCLEAR SCIENCE ABSTRACTS

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February 28, 1975

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Volume 31, Number 4, February 28, 1975

NUCLEAR SCIENCE ABSTRACTS

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Published by the ERDA Technical Information Center

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CARTER, G., See REED, D.J., 30:21824
CASA, A.F., Nuclear energy in Japan, 30:23243
CASARETT, A.P., See KALLFELZ, F.A., 30:21411
CASCI, C., Method for preliminary analysis of MHD generator performance, 30:20916 (AGARD-CP-104)

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REACTOR CORES/INSPECTION
Initial results of a holographic tomosynthesis technique for fuel-core inspection, 30:23198
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Preliminary data report: post-irradiation examination of fuel pins PNL-10-23 and PNL-10-63, 30:23149 (HEDL-TME-74-23)
Prototype applications loop two years of operation, 30:20928 (HEDL-TME-74-24)

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Activation and Nuclear Reaction Procedures

Refer also to abstracts 8584, 8811, 8976, and 10002.

8135 SEPARATION OF ANTIMONY FROM ARSENIC AND COPPER BY EXTRACTION CHROMATOGRAPHY. Polito, W. L.; Lima, F. W. (Inst. of Atomic Energy, Sao Paulo, Brazil). Radiochem. Radioanal. Lett.; 19: No. 5-6, 297-302(23 Nov 1974).

Arsenic and copper can be rapidly and quantitatively separated from antimony by extraction chromatography using silica-gel impregnated with tribenzylamine (TBA) as a stationary phase and hydrochloric acid solutions of As(V), Cu, and Sb(V) as mobile phase. Antimony is retained in the silica-gel column, while copper and arsenic are collected in the effluent. A separation run takes about 30 minutes. (auth)

8136 EXTRACTION OF MERCURY(II) WITH LIQUID ION EXCHANGERS FROM ACETATE BUFFER SOLUTIONS. Separation of Mercury(II) From Zinc(II), Cadmium(II), and Thallium (III)). Singh, O. V.; Tandon, S. N. (Univ. of Roorkee, India). Radiochem. Radioanal. Lett.; 19: No. 5-6, 371-376(23 Nov 1974).

The extraction of mercury(II) with liquid ion exchangers from acetate buffer solution has been studied using tracer techniques. The extraction efficiency of various amines follow the order primary>tertiary>secondary. The extractions of zinc(II), cadmium(II) and thallium(III) were negligible under identical conditions, therefore, mercury(II) can be conveniently separated from these elements with high separation coefficients. This method of separation is used in the determination of mercury by activation analysis. (auth)

8137 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF STANDARD BIOLOGICAL MATERIALS. Becker, R. R.; Veglia, A.; Schmid, E. R. (Univ., Vienna). Radiochem. Radioanal. Lett.; 19: No. 5-6, 343-354(23 Nov 1974).

The applicability of standard biological reference materials in the determination of toxic and essential trace elements in foods and feeds by instrumental neutron activation analysis using a Ge(Li) semiconductor detector was investigated. The analyzed standard materials were Bowen's Kale and the NBS standard reference materials 1571 (Orchard Leaves) and 1577 (Bovine Liver). Results are given for the elements Mo, Se, Cr, Fe, Zn, Co, As, Br, Sb, Hg, La, Rb, Cs, Sc, and Eu and compared with the "best values" proposed by Bowen and with the NBS certified or proposed values. The accuracy and the precision of the method are discussed. Kale is an excellent standard reference material for feeds and Bovine Liver for meat samples. Orchard Leaves is of limited value. (auth)

8138 NONDESTRUCTIVE DETERMINATION OF TRACE AMOUNTS OF HAFNIUM IN ZIRCONIUM MATRIX BY NEUTRON ACTIVATION ANALYSIS FOLLOWED BY HIGH RESOLUTION GAMMA RAY SPECTROMETRY. Lavi, N. (Soreq Nuclear Research Center, Yavne, Israel). Radiochem. Radioanal. Lett.; 19: No. 4, 243-250(8 Nov 1974).

A method is described for determining hafnium impurities in a zirconium matrix by means of neutron activation analysis followed by high resolution gamma-spectrometry. The method is fast, selective, highly sensitive and nondestructive. It is based on the measurement of the short-life isotope ^{179m}Hf (18.6 sec). The accuracy of the method is generally better than ±5% over the weight range 0.1-5.0 μg of hafnium. Analysis time is one minute per sample. (auth)

8139 APPLICATION OF INSTRUMENTAL Ge(Li) GAMMA SPECTROMETRY IN ENZYME CHARACTERIZATION. Hewitt, P. J.; Large, P. J. (Nuclear Science Univ. of Bradford, Eng.). Radiochem. Radioanal. Lett.; 19: No. 4, 251-254(8 Nov 1974).

Purified amine dehydrogenase from Pseudomonas AM1 has been analyzed using neutron activation and direct instrumental Ge(Li) γ spectrometry. The copper content of the enzyme was found to be nonstoichiometric suggesting a nonfunctional role. Other experimental evidence supports this conclusion. The technique described is particularly suited to enzyme analysis where metal activation is suspected. (auth)

8140 OPTIMUM IRRADIATION, DECAY, AND COUNTING TIMES IN ACTIVATION ANALYSIS FOR SINGLE AND DOUBLE COUNTING AND FOR DIFFERENT MINIMIZATION FUNCTIONS. Zikovsky, L. (Ecole Polytechnique, Montreal). J. Radioanal. Chem.; 22: No. 1-2, 165-172(1974).

The optimum irradiation, decay, and counting times were calculated for single and double counting in the case of 3 isotopes. Two different minimization functions were considered. The results, presented in graphical form, make possible the estimation of the optimum times for the majority of practical cases. An important gain in sensitivity can be obtained by using a double counting technique. (auth)

8141 EXTRACTION STUDIES OF THE GROUP IB, IIB, AND IIIA–VA ELEMENTS USING 1-(2-PYRIDYLAZO)-2-NAPHTHOL AS CHELATING REAGENT. Qureshi, I. H.; Cheema, M. N. (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). J. Radioanal. Chem.; 22: No. 1-2, 75-82(1974).

The extraction of PAN chelates of the group IB, IIB, and IIIA-VA elements from aqueous solutions of pH 1-10 into chloroform has been studied radiochemically. Re-extraction studies have been made to strip the metal ions from the organic phase into aqueous solutions of KCN, $HClO_4$ and buffer solutions. The effects of certain masking agents on the extraction of these elements have also been studied. The extraction curves indicate the possibilities of devising group chemical separation procedures for use in activation analysis. (auth)

8142 NEUTRON ACTIVATION DETERMINATION OF IMPURITIES IN HIGH-PURITY ZINC. Mousty, F.; Girardi, F. (C. C. R. Ispra, Italy). J. Radioanal. Chem.; 22: No. 1-2, 29-43 (1974). (In Italian).

A destructive method for the measurement of impurities in high-purity zinc by neutron activation analysis is described. It essentially uses organic resins and inorganic exchangers for the separations. Sensitivities at the ppb level are obtained for a high number of elements. (auth)

8143 LEAD ANALYSIS IN LUNAR MATERIALS USING CYCLOTRON IRRADIATIONS. Allen, R. O. Jr. (Univ. of Virginia, Charlottesville); Reed, G. W. Jr. J. Radioanal. Chem.; 22: No. 1-2, 63-74(1974).

The analysis of less than 10^{-9} g of the isotope ^{204}Pb in lunar samples was carried out by an (n, 2n) activation using high energy (>8.8 MeV) neutrons. A procedure of using the neutrons produced by bombardment of a specially designed Be sample holder with deuterons in a cyclotron was developed and compared to irradiation carried out in the core of a nuclear reactor. Radiochemical separations and x ray$-\gamma$ ray coincidence counting techniques are necessary to achieve the required sensitivity. Although the flux of neutrons of sufficient energy from the cyclotron procedure is somewhat lower than can be obtained in the best reactor irradiations, the high radioactivity due to other elements produced by the (n,γ) reactions in the reactor is eliminated. Radiochemical procecures for the analysis of Bi, Tl, Zn in the same samples are also described. (auth)

8144 DETERMINATION OF OXYGEN AND SILICON IN DIAMOND BY 14-MeV NEUTRON ACTIVATION ANALYSIS. Bibby, D. M.; Sellschop, J. P. F. (Univ. of the Witwatersrand, Johannesburg). J. Radioanal. Chem.; 22: No. 1-2, 103-111(1974).

Techniques for the measurement of low levels of oxygen and silicon, using fast neutron activation analysis, were developed and applied to high-quality diamonds. For oxygen, a limit of detection of approximately 5 μg has been established. Sources of error were studied and eliminated, the ubiquitous occurrence of oxygen being the major problem. Within the accuracy of this work, the results obtained show no significant differences in the oxygen contents of diamonds of different types, or of diamonds from different sources. An oxygen content of 35 ± 4 ppm has been established for high-quality colourless diamonds. For silicon, a limit of detection of 25 μg was established and the average silicon content of these diamonds was found to be less than 3 ppm. It is concluded that the oxygen in high-purity diamonds is present as CO_2 or H_2O and not in silicate inclusions. (auth)

8145 USE OF PHENOL–FORMALDEHYDE RESIN BINDING FOR SAMPLE PREPARATION IN ACTIVATION ANALYSIS. Kolomiytsev, M. A.; Dundua, V. Yu.; Pachulia, N. V.; Bagdavadze, N. V. (Inst. of Physics, Tbilissi, USSR). J. Radioanal. Chem.; 22: No. 1-2, 95-102(1974).

The possibility is shown of preparing mechanically strong samples out of friable and powdery material for neutron activation analysis. The properties of the polymer-bound samples were studied, including the change of volatility of bromine and the methods of removing the surface impurities introduced before irradiation. (auth)

8146 CAMAC-BASED INSTRUMENTATION FOR A NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS SYSTEM. de Bruin, M.; Korthoven, P. J. M. (Interuniversity Reactor Inst., Delft, Netherlands). J. Radioanal. Chem.; 22: No. 1-2, 131-138 (1974).

The measuring system described developed for nondestructive neutron activation analysis, consists of a semiconductor detector gamma spectrometer and a sample changer coupled to a PDP-9 computer via a CAMAC interface system. CAMAC modules implemented in this system are an ADC interface, a sample changer control, display unit, a timer and a time-of-the-year clock. The spectra are accumulated in a section of the computer memory. The computer is further used for experiment control and for the analysis and interpretation of the measured gamma spectra. (auth)

8147 TRACE DETERMINATION OF ZIRCONIUM USING CHARGED PARTICLE ACTIVATION. Kormali, S. M.; Schweikert, E. A. (Texas A and M Univ., College Station). J. Radioanal. Chem.; 22: No. 1-2, 139-145(1974).

Reaction yields on thick zirconium targets with proton, deuteron, ^{3}He and ^{4}He activation have been measured and compared. The most favorable reaction combining high sensitivity and selectivity was found to be Zr(p, xn)^{90}Nb. The absolute cross-section for this excitation function has been measured for proton energies up to 20 MeV. Analytical applications are illustrated with nondestructive zirconium analyses in glass. Yields from the thick target experiments indicate that the detection limit for this zirconium analysis method is ~1 ppb. (auth)

8148 NEUTRON ACTIVATION ANALYSIS OF AIRBORNE PARTICULATES IN TAIWAN. I. Chou, C. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan); Pung, T. C.; Tsai, H. T.; Wu, S. C.; Lo, M. C.; Wei, V. H.; Hsu, T. M.; Tsien, J. C.; Yang, C. F. Nucl. Sci. J. (Taiwan); 11: No. 3, 148-153(Sep 1974). (In Chinese).

Neutron activation analysis was applied to the analysis of airborne particulates by gamma spectrometry using a high resolution Ge (Li) detector. Airborne particulate samples were collected at 22 consistent air sampling stations in different areas in Taiwan, and 12 consistent elements, Zn, As, La, Eu, Hg, Sc, Cr, Fe, Co, Ag, Sb, and Au were determined. (auth)

8149 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS FOR THE DETERMINATION OF URANIUM, THORIUM, AND RARE EARTHS IN YELLOW MONAZITE. Chao, S. E.; Lu, W. D.; Wu, S. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 3, 137-147(Sep 1974).

An activation analytical method for the determination of uranium, thorium, and rare earths in a local yellow monazite sample is described. The samples were irradiated in the Zero Power Reactor at Lung-Tan and measured with a high resolution Ge(Li) detector without any chemical separation. The precision of the method is in general about 3%. (auth)

8150 DETERMINING IMPURITIES OF SODIUM, CHROMIUM, TITANIUM, VANADIUM, AND MANGANESE IN RUBY BY NEUTRON ACTIVATION ANALYSIS. Abdukadyrova, I. Kh.; Vakhidov, Sh. A.; Khatamov, Sh.; Khatamov, D. R. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 73-74(1974). (In Russian).

Ruby crystals and standards were irradiated in a reactor at a flux of 1.8×10^{13} neutrons/cm^2 s. The impurity content was calculated from the area under the gamma peaks. The sodium peak could not be detected even though there was 10^{-2} to 10^{-3} wt % Na in the ruby. A 20-hour irradiation was optimum for detecting Cr which was found in amounts of 5×10^{-1} to 10^{-5} wt %. Titanium was determined by the ^{46}Ti(n,p)^{46} Sc reaction, and was found in amounts of 10^{-2} to 10^{-3} wt %. Vanadium was determined from the induced ^{52}V activity. Manganese in amounts of 10^{-4} to 5×10^{-6} wt % was determined by the ^{55}Mn(n,γ)^{56}Mn reaction. Thus because of the correlation of the results of optical studies with activation data, it is possible to establish the connection between the formation of a number of emission centers in ruby and the presence of Cr, Ti, Mn, and V ions. (SJR)

8151 RADIOCHEMICAL SCHEME FOR THE QUANTITATIVE ISOLATION AND GAMMA-SPECTROMETRIC DETERMINATION OF La, Ga, Hf, AND Sc IN NEUTRON ACTIVATION ANALYSIS OF REFRACTORY MATERIALS. Foldzinska, A.; Dybczynski, R. (Inst. of Nuclear Research, Warsaw). J. Radioanal. Chem.; 21: No. 2, 507-517(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

A new radiochemical scheme for the quantitative isolation of Ga, Sc, Hf, and La, based on ion exchange and extraction chromatography, was devised. Ga and Sc were selectively retained on a Dowex 50WX2 [H$^+$] column from 10M HBr at 50°C. Ga was then eluted with ethyl acetate 0.25M in HBr, and scandium with 4M HBr. Hf was separated from 10M HBr at 75°C on a Kel-F column impregnated with tri-n-octylphosphine oxide (TOPO). The lanthanum fraction, after evaporation to dryness, was purified by ion-exchange chromatography in the system: Dowex 50WX8 [H$^+$] – HCl. The effect of accompanying elements, and also the differences in the mechanism of uptake by the resin of various elements from concentrated HBr solution are briefly discussed. The scheme has been used for the determination of these four elements in refractory materials by activation analysis. As this procedure assured practically quantitative isolation of Ga, Sc, Hf and La, the addition of carriers and determination of chemical yield were unnecessary. The radiochemical purities of the respective fractions were as a rule high, and the measurements were performed by NaI(Tl) spectrometry. The detection limits were of the order of fractions of ppm, and could be considerably improved if necessary by increasing the counting time and sample weight. (auth)

8152 SEPARATION OF GERMANIUM FROM SOME ELEMENTS BY ADSORPTION ON SILICA GEL. Caletka, R. (Nuclear Research Inst., Rez, Czech.); Kotas, P. J. Radioanal. Chem.; 21: No. 2, 349-353(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

In the search for an efficient method of recovery of germanium from concentrated mineral acid solutions, silica gel has been found to be a selective adsorbent for this element. A method of quantitative separation of gallium from germanium is described which can be applied for the preparation of ^{68}Ge$-$^{68}Ga isotope generator and for the isolation of ^{68}Ge from a zinc target. The applicability of the present method was also studied for the separation of a germanium matrix in determining admixtures in semiconductor germanium samples by activation analysis. (auth)

8153 RADIOCHEMICAL SEPARATION OF FLUORINE ON APATITE. Fedoroff, M. (Centre d'Etudes de Chimie Metallurgique, Vitry-sur-Seine, France); Debove, L.; Loos-Neskovic, C. J. Radioanal. Chem.; 21: No. 2, 331-339(1974). (In French).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The radioisotope ^{18}F with a half-life of 110 min is produced in order to determine fluorine and oxygen by γ photon or charged particles activation. This radiosiotope is a β^+ emitter and must be separated from other radioisotopes produced from the analyzed matrix. The separation was achieved by fixation of fluorine on a plombo-stronsic hydroxyapatite, prepared by synthesis in aqueous medium. Studies of the distribution of radioactive fluorine between the apatite and solutions of variable compositions, showed the optimal conditions, for the separation from the following metals: Al, Mg, Fe, Mo and from the Al–Mg alloy. The separation was applied to the determination of fluorine by γ irradiation and of oxygen by ^{3}He irradiation. Due to the great selectivity of this separation, radiochemically clean fluorine is obtained and the limit of detection is lowered. (auth)

8154 RADIOCHEMICAL INVESTIGATIONS OF FAST NEUTRON-INDUCED LOW-YIELD NUCLEAR REACTIONS. Qaim, S. M.; Woelfle, R.; Stoecklin, G. (Kernforschungsanlage, Juelich, Ger.). J. Radioanal. Chem.; 21: No. 2, 395-405(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

Radiochemical separation methods for K, Mn, Cu, Ga, Sr, Y, Nb, Ag, I, Ce, Eu, Lu, and Pt, employing precipitation, adsorption, distillation, solvent extraction, or ion-exchange, as used in the investigations of rare nuclear reactions such as (n,t) and (n,^{3}He) at 14.6 MeV, are described. For studying the (n,t) reaction at 23 MeV a method for the vacuum extraction and "low-level" gas-phase counting of tritium is outlined. The measured nuclear reaction cross-section data are discussed briefly. (auth)

8155 NEUTRON ACTIVATION DETERMINATION OF URANIUM BY COPRECIPITATION OF ^{239}Np ON ZIRCONIUM PHOSPHATE. Kuleff, I.; Todorovsky, D. (Univ., Sofia). J. Radioanal. Chem.; 21: No. 2, 445-451(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

A method is proposed for neutron activation determination of U via ^{239}Np. This is separated by coprecipitation of $ZrO(H_2PO_4)_2$ and its 106 keV γ-peak measured. The sensitivity of the determination is 10^{-8} g. The method is based on the well-known ability of Np(IV) to coprecipitate with zirconium phosphate, while Np(VI) does not form insoluble phosphates or fluorides. This permits elimination of elements interfering with the determination of ^{239}Np via the 106 keV γ-peak: Sm, Nd, Yb, Lu, Pa (from Th) and Ta. The rare earths are eliminated by coprecipitation on LaF_3, and Pa and Ta as insoluble phosphates in an oxidizing medium. The method is suitable for phosphorus-containing samples: phosphorites, apatites and their industrial treatment products. The results obtained for the uranium content with the proposed method are in good agreement with the results of other methods and authors. (auth)

8156 PRODUCTION OF HIPPURAN-^{131}I IN THE BORIS KIDRIC INSTITUTE, VINCA. III. Trace Elements in Hippuran and its Radiopharmaceutical Preparation Labelled with ^{131}I. Ratkovic, M.; Draskovic, R. S.; Draskovic, R. J. (Boris Kidric Inst., Vinca, Yugoslavia). Isotopenpraxis; 10: No. 9, 330-332(Sep 1974).

Trace elements were determined in hippuran and the corresponding radiopharmaceutical preparation, labelled with ^{131}I, by using nondestructive radioactivation analysis. The presence of Cr, Hg, Au, Sb, Sc, Fe, Co, Na, Zn, and Br in the above compounds was proved and their concentration determined. (auth)

8157 DETERMINATION OF GOLD IN PLATINUM BY NEUTRON ACTIVATION ANALYSIS. Spevackova, V.; Krivanek, M. (Nuclear Research Inst., Rez, Czech.). J. Radioanal. Chem.; 21: No. 2, 485-488(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The determination of gold in platinum by neutron activation analysis is described. The possibility of screening out the influence of the nuclear reactions $^{196}Pt(n,\gamma)^{197}Pt \xrightarrow{\beta^-} {}^{197}Au$ on the final result of the determination was studied. In the case of microamounts of gold in platinum, gold was separated previously by extraction chromatography with dithizone as organic stationary phase. Gold fixed on the column was irradiated and determined gamma spectrometrically. (auth)

8158 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS IN THE DETERMINATION OF THE $^{235}U/^{238}U$ ISOTOPIC RATIOS FOR SAMPLES FROM 0.4 TO 93% ^{235}U. Lu, W. D. (Inst. of Nuclear Energy Research, Taiwan). J. Inorg. Nucl. Chem.; 36: No. 11, 2433-2437(Nov 1974).

A simple neutron activation method for the determination of the $^{235}U/^{238}U$ isotopic ratios up to 93% ^{235}U using a high resolution Ge(Li) detector for γ detection is reported. The $^{235}U/^{238}U$ weight ratios are determined from the activity ratios of $^{143}Ce/^{239}Np$. The 293 and 278 keV γ-rays from respectively ^{143}Ce and ^{239}Np are chosen for their activity measurements. With well thermalized neutrons (thermal/epithermal ~ 50) the isotopic ratios can be determined for samples with ^{235}U contents from 0.4 to about 35%. The accuracy is around 2 to 3%. With increasing ^{235}U contents the intensity of the 278-keV γ-ray of ^{239}Np becomes too weak to be measurable. Therefore, for samples of high ^{235}U contents epithermal neutrons must be used in the activation to enhance the relative production rate of ^{239}Np with respect to that of fission products. The epithermal neutrons are obtained by means of cadmium filters. With samples well shielded by cadmium filters (i.e. inside a closed cadmium case), the enhancement of the relative production rate of ^{239}Np to that of ^{143}Ce is found to be about 80-fold compared with the activation of well thermalized neutrons. The accuracy may be improved by using several fission products to ^{239}Np activity ratios. The amount of uranium sample needed for a single determination is only 100 to 200 μg. (auth)

8159 DETERMINATION OF IODINE IN SOIL BY THE INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Benes, J. (Lab. of Radiological Dosimetry, Prague); Frana, J. Mastalka, A. Collect. Czech. Chem. Commun.; 39: No. 10, 2783-2786 (Oct 1974).

The instrumental activation analysis, based on the employment of the radiation of short-lived nuclides, has been used for the determination of iodine in soil samples. The limits of this determination and the factors affecting it have been determined. Moreover, the possibility of determining other elements in soils has been studied. The method has been used for their fast chemical analysis. The method has insufficient reactivity for iodine determination without the preliminary removal of interfering elements. (JSR)

8160 SIMULTANEOUS NEUTRON-ACTIVATION DETERMINATION OF SELENIUM AND MERCURY IN BIOLOGICAL SAMPLES BY VOLATILIZATION. Byrne, A. R.; Kosta, L. (Nuklearni Inst. Jozef Stefan, Ljubljana, Yugoslavia). Talanta; 21: No. 10, 1083-1090(Oct 1974).

A method is described for the determination of selenium together with mercury in biological samples by neutron-activation analysis based on quantitative volatilization of both elements. The technique originally developed for mercury, based on pyrolysis with filtration of undesirable impurities and selective trapping from the gas phase, is now extended to selenium. The radionuclides ^{197}Hg and ^{75}Se, from one sample, are trapped separately and counted in a well-type NaI(Tl) detector and γ-spectrometer for maximum sensitivity. The method has been tested by comparative analyses and analyses of standard biological materials, and gives good results. It is simple and is especially effective in studies of the interaction of mercury and selenium in biological systems; a positive correlation for these elements was found for human tissues. (auth)

8161 MEASUREMENT OF ^{129}I BY LIQUID SCINTILLATION AND NaI(Tl) SCINTILLATION METHODS. Horrocks, D. L. (Scientific Instruments Division, Beckman Instruments Inc., Irvine, Calif. 92664, U.S.A.). Nucl. Instrum. Methods; 120: No. 2, 345-350(1 Sep 1974).

The radionuclide ^{129}I can be measured by either liquid scintillation or NaI(Tl) scintillation methods because its decay leads to the emission of both electrons and gamma- or x-rays. The pulse-height spectra obtained with each detector type is presented and interpreted. Typical counting efficiencies obtained were 75% in a well-type NaI(Tl) detector and 95% in an emulsion-type liquid scintillation system and a commercial coincidence-type counter. (auth)

8162 AUTOMATIC NEUTRON ACTIVATION ANALYSIS SYSTEMS FOR ON-LINE MEASUREMENTS IN INDUSTRIAL PROCESSES. Perdijon, J. (CEN, Grenoble, France). Talanta; 21: No. 10, 1047-1064(Oct 1974). (In French).

After a statement of the main requirements for an analytical system to be suitable for use in industry, a detailed examination is made of the response of each part of an activation installation (choice of neutron source and detector, transfer system for standards and samples, data handling) to these requirements. Several applications already established in industry are mentioned (determination of oxygen, nitrogen, fluorine, silicon). Some continuous analyses are also mentioned. (auth)

Chemical and Spectral Procedures

Refer also to abstract 10460.

8163 (MLM–2115) ANALYTICAL POTENTIAL OF X-RAY PHOTOELECTRON SPECTROSCOPY (ESCA). Black, J. N. (Mound Lab., Miamisburg, Ohio (USA)). 22 Nov 1974. Contract AT(33-1)-Gen-53. 61p. Dep. NTIS $5.45.

This report was prepared to provide a survey of the characteristic features, problems, and capabilities of x-ray photoelectron spectroscopy for use in applied analytical problems. This document is designed to introduce the ESCA technique to those technical personnel who are not familiar with the many facets and potential applications of the method. An attempt has been made to assemble the basic concepts of the ESCA technique in one publication and determine its applicability to a wide range of problems. Consequently, this report includes qualitative and quantitative examples which illustrate the current potential of the method, as well as a survey of the commercially available instrumentation. (auth)

8164 (MLM-2177) PROCEEDINGS OF THE SYMPOSIUM ON THE CALORIMETRIC ASSAY OF PLUTONIUM, OCTOBER 24–25, 1973. Strohm, W. W.; Hauenstein, M. F. (comps. and eds.). (Mound Lab., Miamisburg, Ohio (USA)). 4 Oct 1974. Contract AT-33-1-GEN-53. 128p. (CONF-731093-). Dep. NTIS $5.45.

From proceedings on calorimetric assay of plutonium; Miamisburg, Ohio, USA (24 Oct 1973).

The twelve papers presented at the conference are compiled. Separate abstracts were prepared for each. (JSR)

For abstracts of individual papers see: 8165–8174, 8190, and 8191.

8165 (MLM-2177, pp 4-5) INTRODUCTION TO THE SYMPOSIUM ON THE CALORIMETRIC ASSAY OF PLUTONIUM. Bartels, W. C. (Atomic Energy Commission, Washington, DC). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

The need for precision and accuracy in the determination of Pu under new AEC regulations is emphasized. Some examples of the use of calorimeters for this purpose are given. (JSR)

8166 (MLM-2177, pp 6-13) NONDESTRUCTIVE ASSAY GUIDES FOR SPECIAL NUCLEAR MATERIAL CONTROL. Glancy, J. E. (Atomic Energy Commission, Washington, DC). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

The Atomic Energy Commission is continuing its program to determine acceptable techniques for measuring the various forms of special nuclear material encountered in nuclear fuel processing. These measurement methods are being documented in Regulatory Guides issued by the AEC for the purpose of illustrating satisfactory means for implementing its regulations. Nondestructive assay is the recommended approach on heterogeneous material forms not amenable to traditional destructive analysis. The two non-destructive assay guides now available and the 15 soon to be published are presented and discussed. The Regulatory Guide on the calorimetric assay of plutonium, developed in cooperation with the INMM standards committee N15, is reviewed with particular emphasis on acceptable methods for converting power to plutonium content and the use of calorimetry for NDA standards preparation and certification. (auth)

8167 (MLM-2177, pp 14-34) FUNDAMENTALS OF CALORIMETRIC ASSAY. Rodenburg, W. W. (Mound Lab., Miamisburg, OH). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

The basic principles of calorimetric assay are outlined and applied to the nuclear fuel industry. The components of a calorimetric system are given and its operation is described. The practical aspects of calorimetry, as opposed to other nondestructive test methods, are outlined with examples of experience gained at Mound Laboratory. The commercial availability of calorimeters is indicated. (JSR)

8168 (MLM-2177, pp 35-44) DETERMINATION OF PLUTONIUM ISOTOPIC COMPOSITION BY MASS SPECTROMETRY AND ALPHA SPECTROMETRY, AND AMERICIUM-241 CONTENT BY RADIOCOUNTING. Pietri, C. E. (New Brunswick Lab., NJ). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

The determination of plutonium isotopic composition at the New Brunswick Laboratory involves the following considerations. The mass spectrometric determination of isotopic composition with high precision and accuracy requires a separation of any uranium from the plutonium. To avoid the interference of ^{241}Am with the ^{241}Pu determination, americium must also be separated from the plutonium fraction. Finally, since traces of uranium may accompany the plutonium in the separation and may give high ^{238}Pu values because of the ^{238}U mass, the ^{238}Pu content is best determined by alpha spectrometry. Americium-241 is determined at this laboratory by either a direct gamma counting method in the presence of plutonium or by a separations procedure using thenoyltrifluoroacetone (TTA)/tributyl phosphate (TBP) extractions and alpha counting. (auth)

8169 (MLM-2177, pp 66-74) CALORIMETRY AT DOW ROCKY FLATS. Oetting, F. L. (Dow Chemical Co., Golden, CO). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

The first analytical calorimeter constructed at Rocky Flats is described along with the research and development efforts pertaining to analytical calorimetry which deal primarily in the area of half-life determination of particular isotopes of interest to our facility. The adaptation of the initial calorimeter to production calorimetry and a brief summary of the function of the analytical calorimeters now used in the production facilities are given. (auth)

8170 (MLM-2177, pp 75-93) CALORIMETRY OF PLUTONIUM RECYCLE FUELS: APPLICATIONS, INCENTIVES, AND NEEDS. Bishop, D. M.; Taylor, I. N. (General Electric Co., San Jose, CA). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

Calorimetric assay experience during the fabrication of Light Water Reactor (LWR) plutonium recycle fuels is presented. Sources of heat generation and measurement uncertainty on $(Pu,U)O_2$ fuels are related to plutonium burnup history. Process applications, including feed, process, and scrap materials streams, are discussed. Total calorimetric measurement uncertainties are shown to relate to ^{238}Pu and ^{241}Am abundance and measurement capability. Calorimetric measurement errors as a function of process application and plutonium burnup history are defined. Development needs are identified to facilitate the implementation of calorimetric assay methods as a routine analytical tool in licensee plutonium processing facilities. (auth)

8171 (MLM-2177, pp 94-95) CALORIMETRY AT BABCOCK AND WILCOX/NUMEC. Nattsas, S. C.; Kubik, R. N. (Babcock and Wilcox Co., Lynchburg, VA). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

The design and construction of the Plutonium Calorimeter, which was built by the Industrial Systems Section for B&W's subsidiary Nuclear Materials Equipment Corporation (NUMEC), is described. The difficulties encountered in building and maintaining this system are discussed. The system's accuracy is assessed. (auth)

8172 (MLM-2177, pp 96-98) CALORIMETRIC VERIFICATION OF PLUTONIUM INVENTORIES FOR SAFEGUARDS SURVEYS. Crouch, R. B. Jr. (Atomic Energy Commission, Albuquerque, NM). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

The development of calorimetric assay of Pu inventories for safeguards surveys is outlined and some results are tabulated. Refinements under study are indicated. (JSR)

8173 (MLM-2177, pp 99-118) SMALL, FAST-RESPONSE CALORIMETERS DEVELOPED AT ARGONNE NATIONAL LABORATORY FOR THE NONDESTRUCTIVE ASSAY OF PLUTONIUM FUEL RODS. Beyer, N. S.; Lewis, R. N.; Perry, R. B. (Argonne National Lab., IL). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

The design and operating characteristics of three calorimeters developed at Argonne for the nondestructive measurement of the plutonium contained in mixed-oxide fuel rods are described. Two of these instruments (i.e., Models 1 and 2) were built to specifically handle the ZPPR (Zero Power Plutonium Reactor) mixed-oxide fuel rods. The third is designed to handle a 36-in. column of fuel contained in jackets having a diameter equal to or less than the ZPPR rods. The bulk of the material in this report concerns the design details and an evaluation of the operating characteristics of Models 1 and 2 based on the experience of using these instruments to nondestructively assay a fuel inventory. A discussion of this inventory measurement program is included and comparisons are made to chemical analyses and other nondestructive measurements. All models are small, portable instruments and require relatively short measurement times compared to those usually expected of calorimeters. One ZPPR fuel rod, which is about $\frac{3}{8}$ in. in diameter by 6 in. long, can be measured at a time on Models 1 and 2. Model III can handle up to six of these rods. Measurement time is 90 min with Model 1 and 20 min with Model 2. The measurement time for Model III has not been accurately determined but current indications are that it should be similar to that of Model 2. Measurement precision for the ZPPR fuel rods, which contain roughly 13 to 26 wt. % Pu, is as good or better than that attainable by most nondestructive assay techniques. The calorimeters are relatively inexpensive to fabricate and are simple to operate. A careful evaluation of Models 1 and 2 was possible because a thorough program of chemical and mass spectrometric analyses of the fuel was conducted concurrently with the calorimetric measurements. Comparisons were also made with measurements obtained with large, high precision, conventional type calorimeters and with other nondestructive assay instruments. Since accurate and reliable measurements of the plutonium isotopic distribution and of the ^{241}Am content of the fuel were available, calculations of the total plutonium content of the rods could be made from the equivalent electrical power measurements made with the calorimeters. A total of 872 different fuel rods were individually measured during this project. These measurements provided sufficient data for a thorough evaluation of the instruments. (auth)

8174 (MLM-2177, pp 119-126) R AND D EFFORTS AT MOUND LABORATORY IN THE CALORIMETRIC ASSAY OF PLUTONIUM. Strohm, W. W. (Mound Lab., Miamisburg, OH). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

Measurements made to demonstrate that calorimetry is capable of accurate and precise assay of commercial grade Pu are reported. The program is directed toward the development and application of a totally nondestructive Pu assay using calorimetry for precise power measurements and γ spectroscopy for Pu isotopic concentrations. Some typical results obtained in this program are tabulated. An error analysis is made of the calorimetric assay of typical FFTF fuel. (JSR)

8175 (NIM-1656) ANALYSIS OF GEOLOGICAL SAMPLES FOR TRACE ELEMENTS BY DIRECT-READING EMISSION SPECTROMETRY. Watson, A. E.; Russell, G. M. (National Inst. for Metallurgy, Johannesburg (South Africa)). 27 Sep 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

The experimental work is described that led to the development of a method for the determination of a number of trace elements in geological samples by use of a direct-reading spectrometer. The technique involves the diluting of a sample in the ratio of 1 part of sample to 3 parts of a buffer consisting of graphite containing 20% lithium fluoride and 0.03% germanium oxide as an internal standard. The mixture is loaded into a special electrode and is excited in a dc arc at 12 A for 80 seconds ±2 seconds. The excitation takes place in an inert atmosphere that is provided by a double flow gas-stabilizing jet. The resulting digital-voltmeter readings for the various elements are read against previously prepared calibration graphs, and the concentrations of the elements in the sample are derived. The elements determined in the direct-reader program are Co, Cr, Cu, Mn, Mo, Ni, Pb, Sn, V, Zn, and Zr. A photographic spectrographic variant of the method, developed at the same time, is also described. It permits the determination of a number of trace elements not in the direct-reader program. The coefficient of variation for the method is 10 to 15%, and the accuracy is of the same order. (auth)

8176 (PB-234326) SURVEY OF MANUAL METHODS OF MEASUREMENTS OF ASBESTOS, BERYLLIUM, LEAD, CADMIUM, SELENIUM, AND MERCURY IN STATIONARY SOURCE EMISSIONS. Final Report, 29 June 1971–30 September 1973. Coulson, D. M.; Haynes, D. L.; Balazs, M. E.; Doider, M. P. (Stanford Research Inst., Menlo Park, Calif. (USA); Environmental Protection Agency, Washington, D. C. (USA)). Sep 1973. Contract EPA-68-02-0310. 162p. (SRI-PYU-1374-FR). NTIS $5.00.

Sources of information were searched for methods of analysis for asbestos, beryllium, lead, cadmium, selenium, and mercury that would be suitable for analyzing stationary source emissions. Methods of analysis were then chosen on the basis of a survey of current knowledge on methodology, ease of using the procedure, availability of the equipment needed to perform the tests, sensitivity based on proposed EPA standards of emission and threshold limit values (TLV), and specificity requirements. One method was chosen for each pollutant. A detailed discussion of how the methods of analysis were selected is presented. These methods of analysis are presented in Appendix 2. Some laboratory and field testing was performed for methods of analysis that required modification of existing methods. The methods of analysis selected in Phase I were tested, evaluated, and then modified if necessary. (auth)

8177 CONCENTRATION OF IMPURITIES OF COMMON ELEMENTS FROM NEODYMIUM HYDROXIDE BY MEANS OF ELECTRODIALYSIS. Khaeva, L. Kh.; Ryabukhin, V. A.; Zarinskii, V. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 29: No. 10, 2023-2025(Oct 1974). (In Russian).

During dispersion of $Nd(OH)_3$ precipitates in NH_4Cl media by using ultrasound, microimpurities of Ca, Cu, Zn, and Co are deposited by electrodialysis with a yield 72 to 98%. This can be used to increase the sensitivity of their determination. The kinetic deposition curves indicate desorption of the impurity ions from the surface and their diffusion from the volume of neodimium hydroxide particles. (auth)

8178 CHROMATOGRAPHIC BEHAVIOR OF Re(VII), Mo(VI), Va(V), AND W(VI) IN SOLUTIONS CONTAINING SALICYLIC, SULFOSALICYLIC AND THIOSALICYLIC ACID. Gaibakyan, D. S.; Sarkisyan, Zh. V. (Erevan State Univ.). Zh. Anal. Khim.; 29: No. 10, 1991-1995(Oct 1974). (In Russian).

Chromatographic behavior of Re(VII), Mo(VI), V(V), and W(VI) has been examined in solutions of salicylic, sulfosalicylic, and thiosalicylic acid by paper chromatography on a thin Al_2O_3 layer. Procedures are suggested of separation of the elements. (auth)

8179 EXTRACTION–PHOTOMETRIC DETERMINATION OF NIOBIUM IN ROCKS BY MEANS OF TRIHYDROXYFLUORONES. Nazarenko, V. A.; Yagnyatinskaya, G. Ya.; Antonovich, V. P. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 29: No. 10, 1977-1980(Oct 1974). (In Russian).

An extraction-photometric procedure is described of determining niobium in rocks with a sensitivity to $2 \cdot 10^{-5}$% Nb. The procedure is based on extraction of a complex of niobium with o-nitrophenylfluorone (or phenylfluorone) into chloroform from hydrochloric acid aqueous-ethanol solution. The complex extracted is a mixed chloroform and ethanol solvated compound. (auth)

8180 USE OF 5, 7-DINITRO-8-HYDROXYQUINOLINE AND RHODAMINE B FOR EXTRACTION–FLUORIMETRIC DETERMINATION OF THORIUM. Granovskii, Yu. V.; Runov, V. K.; Tishchenko, I. S.; Golovina, A. P. (Moscow State Univ.). Zh. Anal. Khim.; 29: No. 10, 1959-1963(Oct 1974). (In Russian).

The mathematical design of experiment technique has been used to find the best conditions for solvent extraction of the ion associate formed by rhodamine B, thorium, and 5, 7-dinitrohydroxyquinoline. These are pH 1.8, $7.0 \cdot 10^{-5}$ mol/l rhodamine B, and $3.8 \cdot 10^{-5}$ mol/l 5, 7-dinitro-8-hydroxyquinoline. The sensitivity of the extraction-photometric determination is 0.007 μg Th/ml. (auth)

8181 USE OF N-CINNAMOLYPHENYLHYDROXYLAMINE FOR AMPEROMETRIC TITRATION OF SCANDIUM AND YTTRIUM. Sheina, N. M.; Gallai, Z. A.; Shvedene, N. V. (Moscow State Univ). Zh. Anal. Khim.; 29: No. 10, 1924-1928(Oct 1974). (In Russian).

Voltammetric curves were obtained of oxidation of CPHA on a graphite electrode over a wide acidity range of the supporting electrolyte (5 M H_2SO_4–pH 8). The current of oxidation of CPHA can be used for end point indication of up to pH 8. Procedures have been worked out of amperometric titration of small amounts of scandium ($1.3-10^{-5}$ mol/l) and yttrium ($8.8 \cdot 10^{-6}$ mol/l). The solubility of the complexes formed was determined. (auth)

8182 DETERMINATION OF RARE EARTHS IN THE PRESENCE OF IRON USING CARBOXYNITRAZO. Savvin, S. B.; Petrova, T. V.; Romanov, P. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 29: No. 10, 1929-1933(Oct 1974). (In Russian).

Separate rare earths can be determined in the presence of large amounts of iron(III) by using carboxynitrazo and complexone III. Lanthanum can be determined in the presence of 650 times its amounts of iron (III) as well as other rare earths with the atomic numbers more than that of neodimium. At its levels ≥0.08%, lanthanum can be determined in steel without separation; at levels <0.08% only partial separation of iron (III) is necessary. The procedure was tested on various steels. (auth)

8183 DETERMINATION OF BARIUM, STRONTIUM, AND BORON IN OILS. Pethoe, A. Koolaj Foldgaz; 6: No. 5, 156-158(1973).

A quick and accurate method of spectrum analysis has been developed for determining Ba, Sr, and B in oils. 100 g oil and additives are slowly distilled in a quartz bowl, the residue is heated and then ignited in a muffle furnace at 550°C. The mixture containing ash is stirred with spectrographic additives and excited by high-voltage sparks in the bores of carbon electrodes. Spectra obtained by spectrograph are measured by means of a spectral line photometer and evaluated by a spectrator calculating machine. References are synthetically prepared from spectrally pure chemicals. (Hung. Tech. Abstr.)

8184 NEW REACTIONS FOR NEPTUNIUM ISOLATION AND DETERMINATION. Novikov, Y. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). J. Radioanal. Chem.; 21: No. 2, 519-526(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The possibility of using photochemical reactions of neptunium oxidation and reduction for analytical and preparation purposes is discussed. Results of Np isolation from alkaline solutions of heptavalent neptunium by sorption, extraction, and coprecipitation are given. The color reaction of Np(IV) with Arsenazo M is described. On this basis a spectrophotometric method of neptunium determination in the presence of a 20-fold uranium amount is suggested. (auth)

8185 DETERMINATION OF VANADIUM IN URANIUM-BASED ALLOYS WITH 1-(2-PYRIDYLAZO)RESORCINOL. Mal'tseva, L. S.; Shalamova, G. G.; Gusev, S. I. (Inst. of Metallurgy, Moscow). Zh. Anal. Khim.; 29: No. 10, 2053-2055(Oct 1974). (In Russian).

A procedure was developed of spectrophotometric determination of vanadium(V) in uranium-based alloys by using 1-(2-pyridylazo)-resorcinol in the presence of hydroxylamine in an acid medium (0.4 N H_2SO_4). A complex is formed with a ratio $V : PAR : NH_2OH = 1 : 1 : 1$, λ_{max} for the complex being at 550 nm and $\epsilon = 30{,}000$. Large amounts of Re, Th, U, Ti, Mo, Mn, Zr, and other elements do not interfere. (auth)

8186 SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM AND ITS APPLICATION TO NIOBIUM-STABILIZED STAINLESS STEEL. Dutta, R. K.; Banerjee, S. (Durgapur Steel Plant, West Bengal, India). Talanta; 21: No. 10, 1091-1094(Oct 1974).

A spectrophotometric method is described for the determination of niobium by means of its reaction with tannin and thioglycolic acid. The yellow-orange color developed with the reagent mixture at pH 4 is measured at 410 to 420 nm and obeys Beer's law between 0.5 and 10 ppm niobium. The method is suitable for the determination of niobium in niobium-stabilized stainless steel and other types of steels containing niobium, but a prior separation of niobium is necessary. Titanium interferes even in traces. (auth)

8187 USE OF ION EXCHANGE METHODS FOR THE DETERMINATION OF TRACE ELEMENTS IN NATURAL WATERS. IV. Uranium, Cobalt, and Cadmium. Korkisch, J.; Goedl, L. (Univ., Vienna). Talanta; 21: No. 10, 1035-1046(Oct 1974). (In German).

A method is described for separating and determining, by spectrofluorimetric or spectrophotometric measurement, traces of uranium, cobalt and cadmium at ppM levels in natural waters. The sample is acidified with HCl, filtered, and after addition of ascorbic acid and potassium thiocyanate, passed through a column of Dowex 1-X8 anion-exchange resin in the thiocyanate form. The three ions are concentrated on the resin as thiocyanate complexes, being at the same time separated from most of the other ions present in the sample. Elution with a tetrahydrofuranmethylglycol–HCl mixture removes other interfering ions, then 6M HCl strips the cobalt, 1M HCl the uranium, and 2M HNO_3 the cadmium. Data are presented for concentrations of uranium (0.01 to 5 ppM) cobalt (0.04 to 1.9 ppM) and cadmium (0.04 to 0.6 ppM) in a large number of water sources in Austria. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 8161, 8623, 8787, 8970, and 10157.

8188 (COO-2292-1) DEVELOPMENT OF A TRITIUM EXCHANGE METHOD FOR DETECTION OF DRUGS OF ABUSE. Final Report, January 1, 1973–July 31, 1974. Goodman, P.; Rennert, A.; Downs, J. (Panametrics, Inc., Waltham, Mass. (USA)). 1974. Contract AT(11-1)-2292. 30p. Dep. NTIS $4.50.

An investigation was undertaken to test the feasibility of using a combination of high pressure liquid chromatography (HPLC) and tritium exchange (TX) techniques for the quantitative analysis of common drugs of abuse and their metabolites. The prototype drugs used were amphetamine · HCl, methadone · HCl, morphine and secobarbital. The HPLC instrument was a standard commercially available single column type. The HPLC effluent was passed through the TX system which consisted of a teflon lined stainless steel column packed with the TX polymer followed by the ionization chamber radiation detector. Carrier liquids possessing active hydrogen atoms in their molecular structure would be tritiated by the TX polymer and therefore could not be used. The choice of HPLC carrier and column was further restricted by the necessity to use a polar system and not use coated columns. Working within these constraints a chromatographic system which was capable of properly separating the prototype drugs could not be obtained. It was demonstrated that secobarbital would be tritiated by the TX polymer but detection of drugs using the HPLC–TX system could not be achieved. Some problems encountered were, (1) presence of water in the carrier fluid, (2) presence of impurities containing active hydrogens in the carrier fluid, and (3) build-up of contamination in the ionization chamber. Efforts to overcome these problems or to reduce them to allowable levels were only partially successful. (auth)

8189 (COO-3563-27) ANALYTICAL PROCEDURES FOR TRANSURANIC ELEMENTS IN SEAWATER AND MARINE SEDIMENTS. Livingston, H. D.; Mann, D. R.; Bowen, V. T. (Woods Hole Oceanographic Institution, Mass. (USA)). 1974. 20p. (CONF-740955-1). Dep. NTIS $4.00.

From 168th national meeting of American Chemical Society; Atlantic City, New Jersey, USA (8 Sep 1974).

A review is given of the procedures used at the Woods Hole Oceanographic Institution for the extraction and concentration of transuranic elements in sea water and sediments, the problems encountered, and the information gained. Of the five possible transuranic contaminants Np, Pu, Am, Cm, and Cf, only Pu and Am have been detected in the marine environment. The extraction and concentration procedure involves the use of yield monitors and coprecipitation. The transuranic elements are then purified from interfering elements. The purification procedures for Pu, Am, Cm, and Cf are described and the interferences to the measurements of each of these elements are discussed. Commercial surface barrier detectors are used for the isotope measurements. Data on the distribution of ^{241}Am and ^{238,239,240,241}Pu are tabulated. (JSR)

8190 (MLM-2177, pp 45-59) PLUTONIUM ISOTOPIC MEASUREMENTS BY GAMMA-RAY SPECTROMETRY. Gunnink, R. (Univ. of California, Livermore). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

Techniques were developed whereby the isotopic and total plutonium analyses can now be made by detecting and properly analyzing gamma rays emitted by the sample. A computerized, prototype system was developed and is now being routinely used at the Savannah River Plant for the nondestructive assay of solution samples. The analyses for ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{241}Am, when it is present, can be made in counting times as short as 10 to 15 min under optimum conditions. Comparison of isotopic ratio values with mass spectrometry generally shows agreement within 0.1% for ^{239}Pu and about 1% for ^{240}Pu and ^{241}Pu. Some preliminary isotopic measurements on solids are also discussed. (auth)

8191 (MLM-2177, pp 60-65) NONDESTRUCTIVE MEASUREMENT OF PLUTONIUM ISOTOPIC AND AMERICIUM CONCENTRATIONS USING GAMMA-RAY SPECTROSCOPY. Haas, F. X. (Mound Lab., Miamisburg, OH). 4 Oct 1974.

In proceedings of the symposium on the calorimetric assay of plutonium.

A nondestructive technique is described to determine the isotopic ratios of ^{238}Pu, ^{240}Pu, ^{241}Pu, and ^{241}Am relative to ^{239}Pu using high resolution gamma spectroscopy. The analysis was developed using small plutonium metal sources on which a complete destructive analysis was performed. The agreement of the isotopic ratios between the two methods is within a few percent. The technique was extended to analyze bulk samples in the weight range of 10 g to 2 kg. Sample compositions include metals, oxides, green cake, fluorides, and ash wastes. (auth)

8192 (SZS-157, pp 232-238) DETERMINATION OF NATURAL TRITIUM CONCENTRATIONS IN WATER SAMPLES. Kollar, J.; Tatara, M.; Chorvat, D.; Trnovec, T.; Szlaurova, M. (Forschungs Institut fuer Arbeitsmedizin und Berufskrankheiten, Bratislava). Mar 1974.

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The method of electrolytic enrichment of water samples was used to determine natural tritium concentrations in water samples. The apparatus used in this method is described. (LK)

8193 (SZS-157, pp 247-257) GAMMA SPECTROMETRIC DATA PROCESSING FOR ENVIRONMENTAL SAMPLE ANALYSIS. Kovacs, M.; Beleznay, E.; Andrasi, A.; Erdelyvari, I. (Central Research Inst. for Physics, Budapest). Mar 1974.

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The combination of gamma spectrometry with computer processing of the measured data was studied as a means of assaying environmental samples. Foodstuffs were analyzed for ^{40}K and ^{137}Cs. Areas of application for this method are discussed. (LK)

8194 RADIO-RELEASE DETERMINATION OF THE RATE CONSTANT OF CORROSION. Jesenak, V.; Toelgyessy, J. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 19: No. 4, 267-273(8 Nov 1974).

A radio-release method is described for the determination of the rate constant of corrosion. Test samples are kryptonated under conditions which lead to a known depth distribution of the radioactive label. They are then counted, exposed to a corrosive medium under controlled conditions and recounted. The equations of the Linhard-Scharff-Shiøtt theory are used to calculate the average penetration depth. (auth)

8195 PRECISION AND SENSITIVITY OF β-BACKSCATTERING DIFFERENTIAL METHOD OF ANALYSIS. Klas, J. (Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 19: No. 5-6, 325-335(23 Nov 1974).

This paper demonstrates that the fluctuating (statistical) error of the analysis in the differential method of registration of backscattered β-radiation is not less than the method of non-compensation. In general, this method is particularly suitable for the estimation of concentration samples with higher content of component (over 10%). Also, equations by means of the theoretical error of the analysis can be obtained by this simple procedure are presented. (auth)

8196 DETERMINATION OF Rb AND Sr CONCENTRATIONS IN ROCKS BY RADIOISOTOPE X-RAY FLUORESCENCE ANALYSIS. Bacso, J.; Balogh, K. (Inst. of Nuclear Research, Debrecen, Hungary). J. Radioanal. Chem.; 22: No. 1-2, 157-164(1974).

A method is described for Rb and Sr concentration determinations in rocks in radioisotope x-ray fluorescence analysis. The yield/concentration ratios were established by increasing the concentrations of the examined elements in the sample and recording each spectrum. The analytical error in the 100–1,000 ppm concentration range was 2–4%, and for 50 ppm about 10%, and the detection limit was 5–10 ppm. (auth)

8197 EXTRACTIVE SEPARATION OF A LANTHANUM TRACER FROM PREPARATIONS ON A CALCIUM CARRIER OBTAINED FROM STEEL SAMPLES. Urbanski, T. S. (Inst. of Nuclear Research, Warsaw). J. Radioanal. Chem.; 22: No. 1-2, 13-19(1974).

The separation of lanthanum from calcium and a number of radioisotopes of other elements by extraction with alkylphosphoric acids and tri-n-butylphosphate was studied. A quantitative method was developed for the separation of a lanthanum tracer from neutron-irradiated preparations on a calcium carrier, obtained from the steel-making process. This method improves the detectability of ^{140}La (from $5 \cdot 10^{-7}$ to 10^{-10} g of La) by γ spectrometry with a scintillation counter, and enables semiquantitative determination of lanthanum with a liquid GM tube, the error involved being about 100% for La contents $>10^{-8}$ g, and about 30% for La contents $>10^{-7}$ g. (auth)

8198 STATISTICAL APPROACH TO THE CHOICE OF CHANNEL-WIDTH IN GAMMA-RAY SPECTROMETRY USING EMPIRICAL RELATIONS BETWEEN RESOLUTION AND GAMMA-RAY ENERGY. Furler, R.; Poppe, H. (Univ. of Amsterdam). J. Radioanal. Chem.; 22: No. 1-2, 45-62(1974).

The problem of extra peak-broadening caused by the finite channel-width in multichannel gamma spectrometry is discussed, using empirical equations for the relations between resolution and energy for NaI(Tl) scintillation detectors and Ge(Li) drift detectors. Relations are derived and graphs designed to estimate the extra peak-broadening at a certain energy, caused by the compromise necessary when using a chosen energy scale in as few channels as possible. (auth)

8199 X-RAY FLUORESCENCE ANALYSIS OF MULTICOMPONENT FILMS BY USING STANDARDS. Darashkevich, V. P.; Malyukov, B. A. Zh. Anal. Khim.; 29: No. 10, 1881-1886(Oct 1974). (In Russian).

A procedure was developed and tested of analysis of film composition and thickness. The procedure expands the applications of x-ray fluorescence analysis of complex composition films. It was used to control the technological obtaining of solid solution films of cadmium selenotelluride $CdSe_xTe_{1-x}$ and to study vacuum-thermal methods of production of the films. (auth)

8200 TRITIUM DETECTION IN AQUEOUS SOLUTIONS COUNTING IRON IONS. Reinhard, G.; Pirrwitz, J. (Technische Univ., Dresden). Isotopenpraxis; 10: No. 9, 335-339 (Sep 1974). (In German).

Detection of tritium in aqueous solutions containing borate and iron ions through liquid-scintillation measurement is reported. The counting efficiency for a constant HTO quantity was determined in relation to the sample composition for various dioxane scintillator systems. It could be shown that the channel ratio method renders possible sufficient quench correction. Furthermore, a scintillator system was optimized in a way, providing tritium detection in solutions containing less than 10^{-7} mol of iron ions with counting efficiency ranging beyond 30%. In aqueous electrolytic solutions to be met for instance in corrosion research with step-by-step cathodic reduction of passive oxide layers containing HTO on iron surfaces, thus, trouble-free recording of tritium content is possible. (auth)

8201 RADIOCHEMICAL DETERMINATION OF RUTHENIUM-106 IN URINE. Naumann, M.; Ubl, G. (National Centre for Radiation Protection, Berlin). J. Radioanal. Chem.; 21: No. 2, 497-505(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The method is based on volatilization of Ru in the form of RuO_4 by distillation of wet-ashed urine with $KMnO_4$, precipitation of Ru hydroxide, and β-counting. Before the distillation, most of the organic compounds are destroyed by wet-ashing with H_2SO_4 and 30% H_2O_2 at 140°C, with subsequent evaporation until fuming. The chemical recovery is determined photometrically at 430 nm using the solution of β-counted Ru hydroxide in KIO_4/KOH reagent. The mean recovery is about 70%. (auth)

8202 ALPHA-SPECTROMETRY IN NUCLEAR FUEL ANALYSIS. Wenzel, U.; Herz, D. (Kernforschungsanlage, Juelich, Ger.). J. Radioanal. Chem.; 21: No. 2, 473-483(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

A survey is given of the analysis of actinide nuclides by means of α-spectrometry in high-level radioactivity process solutions resulting from reprocessing of spent U–Th fuel. Separation of fission products and isolation of the nuclides ^{228}Th, ^{231}Pa, ^{232}U, ^{237}Np, and ^{238}Pu are performed by adsorption, ion-exchange, extraction chromatography, and extraction techniques. After separation, samples for quantitative determination are prepared by electrode-position and measured using a silicon-surface barrier detector combined with a multichannel analyzer. An error estimation is given. (auth)

8203 DETERMINATION OF AIRBORNE ^{203}Hg. Rehak, W.; Ubl, G. (National Centre for Radiation Protection of the GDR, Berlin). J. Radioanal. Chem.; 21: No. 2, 453-460(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

A method is described for the determination of airborne compounds of ^{203}Hg. The method is based on the sorption of Hg on hopcalite (activated copper oxide/manganese oxide) with subsequent monitoring for the gamma-radiation of ^{203}Hg. Aerosol activity in the air is separated by sucking the air through a filter prior to the absorption tube. The sensitivity of the method permits the assessment of less than one tenth of the maximum permissible concentration in air. It is shown experimentally that the separation procedure used is suitable for the determination of airborne mercuric acetate and its thermal decomposition products. (auth)

8204 ELEMENTAL ANALYSIS USING AN ACCELERATOR. Morita, S. (Tohoku Univ., Sendai); Shiokawa, T.; Ishii, K.; Tawara, H. Genshiryoku Kogyo; 20: No. 6, 40-45(Jun 1974). (In Japanese).

Elemental analysis with high sensitivity was carried out on small amounts of samples, by using a Van de Graaff heavy electron corpuscular beam. As the specific x rays were emitted from elements in the ionized samples, the elements and their amounts were determined by x-ray spectrum. The confidence coefficient was 99.7%, the irradiation dose was 30 MCi, and the measurement duration was about 1 hour. The detectability limit ranged from the precision of 10^{-11} g to 10^{-8} g by element. Eleven elements were determined and assayed in 0.05 ml of tomato juice. Analysis of a slice of human liver revealed that elemental components of the liver are different by patient. The analysis on human hair and annual layers of tree by this method demonstrates the history of disease in persons and change and accumulation of environmental contamination for long duration. (JA)

Separation Procedures

Refer also to abstracts 8304 and 10376.

8205 (ORNL-TM-4757) COST COMMENTARY ON A PROPOSED METHOD FOR RECOVERY OF URANIUM FROM SEA WATER. Harrington, F. E.; Salmon, R.; Unger, W. E.; Brown, K. B.; Coleman, C. F.; Crouse, D. J. (Oak Ridge National Lab., Tenn. (USA)). Nov 1974. Contract W-7405-eng-26. 85p. Dep. NTIS $5.45.

A cost commentary review is presented on a method proposed by U. K. investigators for recovery of uranium from sea water by sorption on hydrous titania. The review follows the original proposal in considering primarily water-sorber contact achieved by tidal flow, in a hypothetical plant at Menai Straits, Wales. Cost analyses of civil works, chemical plant, sorber inventory and makeup, chemical consumption, and other charges were based on available information supplemented with estimates, analogies, and some guesses. (In all uncertainties, the more optimistic value was selected.) Together with computer analysis of tides and flow resistances for the hypothetical site, these led to a minimum cost of about $300/lb U at a production rate of about 500 tons U/yr. In general, the results indicate that the cost of uranium from sea water is not likely to be at a lower level than hundreds of dollars per pound, and might be at a much higher level. (auth)

8206 (SZS-157, pp 239-246) STUDY OF POSSIBILITIES TO MAKE ION EXCHANGE SEPARATION METHODS MORE RAPID. Koprda, V.; Szlaurova, M. (Forschungs Institut fuer Arbeitsmedizin und Berufskrankheiten, Bratislava). Mar 1974.

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

Different factors affecting separation of chlorocomplexes of radionuclides of corrosion and fission products by anion exchange chromatography in mixed solvents were studied. The effects of variables on kinetics of exchange process by batch arrangement, as well as on separation process by column arrangement have been confirmed experimentally. The separation time influenced by changes in temperature and resin grain distribution, affecting a number of variables, has been experimentally investigated. Optimum conditions for column separation have been selected. (auth)

8207 SOLVENT EXTRACTION OF Sc AND Zr WITH 1-PHENYL-3-METHYL-4-BENZOYLPYRAZOLONE-5 IN THE PRESENCE OF TETRAETHYLDIAMIDEHEPTYL PHOSPHATE. Fadeeva, V. I.; Putilina, V. S.; Alimarin, I. P. (Moscow State Univ.). Zh. Anal. Khim.; 29: No. 10, 1918-1923(Oct 1974). (In Russian).

Solvent extraction was examined of mixed complexes of scandium and zirconium with 1-phenyl-3-methyl-4-benzoylpyrazolone-5 (HPMBP) and tetraethyldiamideheptylphosphate (DAHP) from mineral acid solutions. At mineral and concentration greater than 5 M, the component ratios as follows: Sc : HPMBP : DAHP = 1 : 1 : 2; Zr : HPMBP : DAHP = 1 : 1 : 1 (HNO_3) and 1 : 2 : 1 (HCl); at pH O, Sc : HPMBP : DAHP = 1 : 3 : 1 ($HClO_4$, HCl). Solvent extraction was studied of some elements under the optimal extraction conditions for scandium and zirconium with a mixture of HPMBP and DAHP. The possibility is shown of separation of zirconium and hafnium, zirconium and scandium. (auth)

8208 CO-SEPARATION OF HAFNIUM WITH ZIRCONIUM OXYCHLORIDE USING ^{175,181}Hf AS RADIOACTIVE TRACER. Purkayastha, B. C.; Sarkar, S.; Mahapatra, N. S. (Saha Inst. of Nuclear Physics, Calcutta). J. Radioanal. Chem.; 22: No. 1-2, 83-93(1974).

Co-separation of hafnium with zirconium oxychloride was studied from 0 to 60°C with the help of ^{175,181}Hf. Zirconium oxychloride undergoes two transitions, one at about 33°C and another at about 59.5°C. From the value of the partition factor it was clear that a separation method based on fractional crystallization of the oxychloride will not be a successful line of approach. The transition points were verified by DTA study. It was found from the DTA curve that hafnium oxychloride undergoes transition near 90°C. The solubility of zirconium oxychloride and the break in the partition factor also corroborate the above findings. (auth)

8209 EXTRACTION OF TRIVALENT LANTHANIDE CATIONS BY DIPHENYL PHOSPHINIC ACID. II. Mechanism of the Extraction. de Almeida, I. G. (Instituto de Engenharia Nuclear, Rio de Janeiro). J. Radioanal. Chem.; 22: No. 1-2, 21-28(1974).

The distribution of trivalent lanthanides between solutions of diphenyl phosphinic acid, $(\phi)_2PO(OH)$, in chloroform and aqueous phases containing nitrate ions was investigated radiometrically. The distribution ratio was studied as a function of mineral acid and salt concentrations in the aqueous phase and extractant concentration in the organic phase, for all lanthanides except Pm. The compositions of the extracted complexes were investigated by the usual slope analysis. The results obtained for a given set of conditions indicate that none of the anions present in the aqueous medium are present in the extracted complex species. For these conditions, the distribution ratio D was found to vary as [extractant]$^{2.7}$ and $[H^+]^{-3}$, where the concentrations refer to the organic and aqueous phases, respectively. It therefore appears that a mixture of complex species is extracted, and the possible structures of these species and a mechanism for the extraction are discussed. (auth)

8210 EXTRACTION OF ^{127}Te BY CYCLOHEXANONE IN HYDROCHLORIC ACID. Shukurov, A. Sh.; Abrarov, O. A. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 6, 24-25(1974). (In Russian).

Tellurium dissolved in HCl solution was extracted with cyclohexanone. The maximum extraction of Te (99%) was obtained in 3N HCl solutions with metal concentrations of 1×10^{-7} to 1×10^{-2} g/ml. It was established that equilibrium between the organic and aqueous phases is reached in 1 min. (JSR)

8211 SORPTION OF RADIOACTIVE STRONTIUM ON BINARY SYSTEMS OF SOME ALKALINE EARTH SULFATES. Vojtech, O.; Suessmilch, J.; Selecka, H. (Nuclear Research Inst., Rez, Czech.). J. Radioanal. Chem.; 21: No. 2, 341-348(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

Equilibrium and metastable solid solutions of binary mixtures of $BaSO_4-CaSO_4$ and $SrSO_4-CaSO_4$, and sorbents based on mixtures of compounds in the systems $BaSO_4-MgSO_4$ and $SrSO_4-MgSO_4$ were prepared by special heat treatments. The sorption properties of such systems were studied in relation to their structural characteristics. A positive effect of the dynamic reconstruction of the lattice on the sorption of strontium ions was found in all cases. Good sorption properties were found for the systems $BaSO_4-CaSO_4$ and $BaSO_4-MgSO_4$. An effort was made to explain the mechanism of sorption on such systems, using several independent methods. (auth)

8212 APPLICATION OF THE ELECTROMIGRATION METHOD TO RADIOCHEMICAL STUDIES. Stepanov, A. V.; Makarova, T. P.; Gritchenko, S. G. (Inst. of Radium, Leningrad). J. Radioanal. Chem.; 21: No. 2, 411-417(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The use of the electromigration method for the separation of mixtures of radioactive substances, for the investigation of various equilibria, e.g. complex formation, and for kinetic studies have been considered. (auth)

8213 AFFINITIES OF INSOLUBLE HEXACYANOFERRATES (II) FOR ALKALI METALS AND AMMONIUM. II. Hexacyanoferrates(II) of Bivalent Manganese, Iron, and Cadmium. Dolezal, J.; Stejaskal, J.; Kourim, V. (Nuclear Research Inst., Rez, Czech.). J. Radioanal. Chem.; 21: No. 2, 363-369(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The affinities of insoluble ferrocyanides of bivalent manganese, iron, and cadmium for sodium, potassium, rubidium, cesium and ammonium were studied. The affinities of the univalent cations for the ferrocyanides generally increased in the usual order $Na < K < NH_4 < Rb < Cs$. Comparing the results with those previously obtained, the affinity towards formation of double ferrocyanides with univalent cations generally follows the order Cd ~ Mn > Co > Fe(II) > Ni > Zn > Cu > Fe(III). The precipitation isotherms of the systems are presented and the relationship between the affinities and some other properties of the transition metal ferrocyanides is discussed. (auth)

8214 SEPARATION OF TELLURIUM(IV) BY SOLVENT EXTRACTION METHODS. Havezov, I.; Jordanov, N. (Bylgarska Academiya na Naukite, Sofia). Talanta; 21: No. 10, 1013-1024 (Oct 1974).

A critical review is given of the contemporary state and the perspectives for development of solvent extraction methods for the separation of tellurium(IV). The literature (150 references) is covered up to the end of 1973. (auth)

8215 EXTRACTION OF ZIRCONIUM(IV) FROM SULPHURIC ACID SOLUTIONS BY LONG-CHAIN ALIPHATIC AMINES. Sato, T.; Watanabe, H. (Shizuoka Univ., Hamamatsu, Japan). J. Inorg. Nucl. Chem.; 36: No. 11, 2585-2589(Nov 1974).

The extraction of zirconium(IV) from sulfuric acid solutions with long-chain aliphatic amines has been investigated. Secondary amines are more efficient extractants for zirconium than tertiary amines; the efficiency increases with the chain length of the alkyl group and is reduced when the alkyl chain in the tertiary amine is branched. The organic solutions from the extraction by tri-n-octylamine (TOA) have been examined by IR and NMR spectroscopy and the mechanism of the extraction by TOA has been studied. (auth)

8216 SOLVENT EXTRACTION OF URANIUM(IV). III. Extraction of Uranium(IV) by di-(2-ethylhexyl) phosphoric Acid from Sulphuric Acid Solutions. Kiwan, A. M.; Amin, R. S. (National Research Center, Cairo). J. Inorg. Nucl. Chem.; 36: No. 11, 2591-2593(Nov 1974).

The distribution of uranium(IV) between sulfuric acid solutions and solutions of di-(2-ethylhexyl)phosphoric acid (HDEHP) in carbon tetrachloride has been investigated at different concentrations of sulfuric acid, extractant, and uranium. Uranium(IV) was found to be extracted into the organic phase as $U(DEHP)_4(HDEHP)_4$ by a cation exchange mechanism. The IR absorption spectra of uranium(IV) complexes in CCl_4 are also recorded and discussed. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 8336.

Chemical and Physicochemical Properties

Refer also to abstracts 8299, 9095, 9098, 9099, 9127, 9280, 9292, and 9293.

8217 (ANL-8121) CHEMICAL ENGINEERING DIVISION, THERMOCHEMICAL STUDIES ANNUAL REPORT, JULY 1973–JUNE 1974. O'Hare, P. A. G.; Johnson, G. K.; Ader, M.; Hubbard, W. N.; Cafasso, F. A.; Burris, L. (Argonne National Lab., Ill. (USA)). Jul 1974. Contract W-31-109-ENG-38. 48p. Dep. NTIS $5.45.

Separate abstracts were prepared for the eight sections of the report. (JSR)

For abstracts of individual sections see: 8218–8225.

8218 (ANL–8121, pp 4-13) MOLYBDATES. O'Hare, P. A. G. Jul 1974.

In Chemical Engineering Division, thermochemical studies annual report, July 1973–June 1974.

In order that well-established values would be available for the enthalpies of formation, ΔH_f°, of all the alkali-metal molybdates, a solution calorimetric study of lithium molybdate, Li_2MoO_4, was performed. The result obtained is -363.26 ± 0.12 kcal mol^{-1}. Based on literature data for several sparingly soluble metal molybdates, a value of -200.0 ± 0.3 kcal mol^{-1} is recommended for $\Delta G_f^\circ(MoO_4^{2-}$, aq, 298.15 K). Based on the measured enthalpy of reaction of cesium dimolybdate, $Cs_2Mo_2O_7$, with CsOH(aq), ΔH_f° ($Cs_2Mo_2O_7$, c, 298.15 K) was found to be -550.3 ± 0.2 kcal mol^{-1}. (auth)

8219 (ANL–8121, pp 14-22) COMPOUNDS OF THE ALKALI METALS AND URANIUM. O'Hare, P. A. G. Jul 1974.

In Chemical Engineering Division, thermochemical studies annual report, July 1973–June 1974.

Existing literature data for $\Delta H_f^\circ(NaUO_3)$ were discordant; determination, based on dissolution of $NaUO_3$ in an aqueous XeO_3 + HCl mixture, gave a value of -357.5 ± 0.8 kcal mol^{-1}. Similarly, because a previous determination of ΔH_f° for alkali metal uranates was suspect, the enthalpies of reaction with HCl(aq), ΔH_r were determined for α-Li_2UO_4, K_2UO_4, and Rb_2UO_4 and new values for ΔH_f° were deduced. The results are as follows: for α-Li_2UO_4 $\Delta H_r = -41.77 \pm 0.02$, $\Delta H_f^\circ = -463.31 \pm 0.84$; for K_2UO_4 $\Delta H_r = -42.07 \pm 0.05$, $\Delta H_f^\circ = -451.39 \pm 0.83$; for Rb_2UO_4 $\Delta H_r = -41.30 \pm 0.05$, $\Delta H_f^\circ = -452.00 \pm 0.85$. A study of $Cs_2U_2O_7$ is in progress. (auth)

8220 (ANL–8121, pp 23-29) LITHIUM NITRIDE AND LITHIUM OXIDE. Johnson, G. K.; O'Hare, P. A. G. Jul 1974.

In Chemical Engineering Division, thermochemical studies annual report, July 1973–June 1974.

Because of the interest in lithium in connection with the Controlled Thermonuclear Research (CTR) program, the enthalpies of formation of two of the most common contaminants of lithium, i.e., the nitride, Li_3N, and the oxide, Li_2O have been determined by solution calorimetry. The results obtained (kcal mol^{-1}) were: $\Delta H_f^\circ(Li_3N$, c, 298.15 K) = -39.42 ± 0.26 and $\Delta H_f^\circ(Li_2O$, c, 298.15 K) = -142.903 ± 0.067. (auth)

8221 (ANL–8121, pp 30) LITHIUM MONOSELENIDE, Li_2Se. Ader, M. Jul 1974.

In Chemical Engineering Division, thermochemical studies annual report, July 1973–June 1974.

Final calculations for the combustion of Li_2Se in fluorine yielded $\Delta H_f^\circ(Li_2Se$, c, 298.15 K) = -101.8 ± 2.0 kcal mol^{-1}. A description of this work appears in J. Chem. Thermodyn. 6, 587 (1974). (auth)

8222 (ANL–8121, pp 31-33) TRIURANIUM SILICIDE, U_3Si. Hubbard, W. N. Jul 1974.

In Chemical Engineering Division, thermochemical studies annual report, July 1973–June 1974.

Triuranium silicide, U_3Si, which has a number of attractive features as a nuclear fuel, has been included in that part of our program which deals with the thermodynamic properties of uranium compounds. A sample was prepared and characterized at the Chalk River, Ontario, laboratories of Atomic Energy and Canada, Ltd. Calorimetric measurements of the enthalpy of reaction of this sample with fluorine have been completed. Derivation of $\Delta H_f^\circ(U_3Si)$ awaits analytical results on the combustion residues. (auth)

8223 (ANL–8121, pp 34-35) VANADIUM CARBIDE. Johnson, G. K. Jul 1974.

In Chemical Engineering Division, thermochemical studies annual report, July 1973–June 1974.

The thermodynamic properties of refractory carbides are basic data needed for understanding the chemistry of carbide fuel-fission product systems. A collaborative effort has been undertaken with E. K. Storms of Los Alamos Scientific Laboratory to determine the enthalpies of formation of the carbides of molybdenum and vanadium. In this report, results of the combustion of a sample of $VC_{0.787}$ in fluorine are given. A preliminary result for $\Delta H_f^\circ(VC_{0.787}$, c,) of ~-26 kcal mol^{-1} was obtained. (auth)

8224 (ANL–8121, pp 36-38) EXPLORATORY EXPERIMENTS IN FLUORINE BOMB CALORIMETRY. Ader, M. Jul 1974.

In Chemical Engineering Division, thermochemical studies annual report, July 1973–June 1974.

Exploratory combustions of WS_2, $MoSe_2$, $MoTe_2$, FeS_2, and Al_2SiO_5 were run to learn if fluorine bomb calorimetry could be readily applied to the determination of their enthalpies of formation. The results were quite satisfactory for WS_2, $MoSe_2$, and $MoTe_2$. For FeS_2 and Al_2SiO_5, success is much more dependent on analysis of reaction products. (auth)

8225 (ANL–8121, pp 39-41) MOLECULAR ORBITAL STUDIES: THE SELENIUM–FLUORINE SYSTEM. O'Hare, P. A. G. Jul 1974.

In Chemical Engineering Division, thermochemical studies annual report, July 1973–June 1974.

Molecular orbital studies of the Hartree-Fock-Roothaan type were carried out for the selenium-fluorine system. Based on these calculations, the spectroscopic constants (r_e, ω_e, $\omega_e x_e$, B_e, and α_e) and the following properties for SeF(g) have been obtained: $\Delta H_f^\circ = -0.8 \pm 2$ kcal mol^{-1}; $S^\circ = 57.26 \pm 0.05$ cal K^{-1} mol^{-1}; ionization potential = 9.4 ± 0.4 eV; electron affinity = 1.8 eV, and dipole moment (Se^+F^-) = 2.05 debye. (auth)

8226 (COO-716-085) INVESTIGATION OF SOME LANTHANIDE CARBON, NITROGEN, CHALCOGEN, AND HALOGEN SYSTEMS AT ELEVATED TEMPERATURES. Progress Report, February 1, 1974–January 31, 1975. Eick, H. A.; Luke, H.; Biefeld, C. G.; Biefeld, R. M.; Clink, B. L.; Richards, J. T. (Michigan State Univ., East Lansing (USA)). [nd]. Contract AT(11-1)-716. 91p. Dep. NTIS $7.75.

The vaporization reactions in the Yb–F, specifically YbF_3 and YbF_2, were examined thermodynamically. The vaporization and sublimation thermodynamics of Sm and Tm fluorides were determined. Attempts were made to grow single crystals of the intermediate phase between $YbCl_2$ and $YbCl_3$. Attempts were made to synthesize new Yb–halide–silicate phases and the results indicated that in the temperature range from 1000 to 1100°C $Yb_2Si_2O_7$ is the most stable phase. The attempt to prepare a crystalline sample of the $YbCl_{2.26}$ phase for structural and thermodynamic studies was described. The crystalline phase obtained was suitable for structural analysis and it was concluded from this analysis that the crystal contained some oxide contaminant. Two mixed halide phases of Eu $EuCl_{0.46}Br_{1.56}$ and $EuCl_{0.16}Br_{1.85}$ were prepared and characterized. (JSR)

8227 (COO-3242-13) ELEMENTARY RATE CONSTANTS FOR HYDROGEN ATOMS. Annual Progress Report, 1973–1974. Michael, J. V. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Chemistry). 1 Sep 1974. Contract AT(11-1)-3242. 159p. Dep. NTIS $11.00.

The projects reported are a flow system experiment in which hydrogen atom concentration is monitored by Lyman α photometry, a real time apparatus which utilizes Lyman α photometry to observe photolytically produced transient concentrations of hydrogen atoms in reacting systems, a steady-state photolytic system in which steady-state hydrogen atom concentration can be observed by Lyman α photometry, a shock tube experiment in which the high temperature reactions of transient hydrogen atoms may be studied by time-resolved Lyman α photometry, a flow system experiment in which hydrogen atom and other neutral atom and molecule concentrations may be observed in reactive systems by time-of-flight mass spectrometry, a steady state experiment where 2537 Å emission of $Hg(^3P_1)$ can be studied as a function of pressure of added quencher, and theoretical calculations. Each of these projects is discussed and the data obtained during the past year are presented. The manuscripts submitted for publication, accepted for publication, and published as a result of these research projects are tabulated. (JSR)

8228 (ORNL–4976, pp 102-113) PHYSICAL CHEMISTRY: ELECTROCHEMISTRY. Oct 1974.

In Chemistry Division annual progress report for period ending May 20, 1974.

The effects of Ti(IV) on the electrochemical behavior of Ti and its relevance to pitting and crevice corrosion were studied. The importance of the finding that Ti(IV) ions have no effect on the constant-potential dissolution rate of Ti, and accelerate rather than inhibit the open-circuit corrosion rate of the metal, is discussed. Continuing research on the separation and analysis of ions with a silver packed-bed electrode is reported. An apparatus was designed, constructed, and tested for investigation of the applicability of packed-bed electrodes to quantitative electroanalysis of trace amounts of oxidizable or reducible solutes in small sample volumes by linear-sweep voltammetry and/or coulometry. Research continued on the development of efficient and economical methods for removal and recovery of reducible inorganic pollutants from aqueous streams, primarily Pb from industrial effluents. A study was made of the electrochemical behavior of the active iron electrode in acidic ethanol–water media. The kinetic order with respect to water and protons in the corrosion mechanism was studied. (JGB)

8229 (ORNL–4976, pp 113-115) PHYSICAL CHEMISTRY: CALORIMETRY. Oct 1974.

In Chemistry Divison annual progress report for period ending May 20, 1974.

Previous studies on the surface properties of thorium oxide were extended to include calorimetric measurements to 200°C. Studies on the heat of immersion of six samples of thorium oxide are given. (JGB)

Isotope Effects

Refer also to abstracts 8324, 8964, 9611, and 9648.

8230 (ORNL–4976, pp 69-70) ORGANIC CHEMISTRY. Collins, C. J.; Johnson, C. K.; Schmidt, W. W. Oct 1974.

In Chemistry Division annual progress report for period ending May 20, 1974.

Research programs included studies on the preparation of charge-transfer complexes, ^{14}C isotope effects during the addition of diphenylketene to styrene, and the 3, 2-hydride shift in bicyclic compounds. In studies on ion pairs in S_N2 reactions, the isotope effect criterion was applied to the hydrolyses, in aqueous acetone solution, of ^{14}C-labeled benzyl chloride, p-methylbenzyl chloride, and 2-octyl brosylate. Both primary ^{14}C and α-deuterium isotope effects were determined during formation of both carbinol and azide. (JGB)

8231 SOME MOLECULAR PROPERTIES OF LiH AND LiD. Docken, K.K. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts 02138); Freeman, R.R. J. Chem. Phys. 61: No. 10, 4217-4223 (15 Nov 1974).

The results of both experiment and theory have been combined to produce some new and accurate properties of LiH and LiD. The measurement of some specific ground state hyperfine and Zeeman energies by molecular beam electric resonance (MBER) is discussed. The importance of vibrationally averaging expressions for molecular constants obtained from accurate experimental measurements as well as molecular properties obtained in theoretical ab initio calculations using well–correlated wavefunctions is emphasized. New values for the electric quadrupole moment of ^7Li and D are presented: $Q_{Li} = -4.26\times10^{-26}$ cm^2 and $Q_D = 2.9\times10^{-27}$ cm^2. In addition, as a check on both experiment and theory, the molecular rotational g_J factor and spin–rotation interaction constants are calculated and compared. (auth)

8232 REACTIVE SCATTERING OF H AND D ATOMS. II. Isotope Effect on the Angular Distribution of H, D + NO_2. Haberland, H.; Rohwer, P.; Schmidt, K. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Chem. Phys. (Amsterdam); 5: No. 2, 298-305(Aug 1974).

The chemical reactions of hydrogen and deuterium atoms with nitrogen dioxide (NO_2) were studied with crossed molecular beams. Angular and velocity distributions were measured. The angular distribution peaks at small angles and shows a pronounced isotope effect; only ~24% of the available energy goes into translation. Although four very deep potential wells (2.1 eV) exist in the potential hypersurface no statistical complex is formed. The reaction can probably be described as intermediate between direct and complex scattering. (auth)

8233 ISOTOPIC EFFECTS IN THE ELECTRON SPECTRA OF $H_2{}^{16}O$, $H_2{}^{18}O$, AND $D_2{}^{16}O$. Bergmark, T.; Karlsson, L.; Jadrny, R.; Mattsson, L.; Albridge, R. G.; Siegbahn, K. (Uppsala Univ. (Sweden). Fysiska Institutionen). J. Electron Spectros. Relat. Phenomena; 4: No. 1, 85-89(Jul 1974).

Isotopic shifts in electron spectra were observed previously when hydrogen atoms were replaced by deuterium. The present paper presents for the first time an isotopic shift in an electron spectrum caused by the isotopic replacement of an element other than hydrogen. The He I induced electron spectra of the three outer orbitals of $H_2{}^{16}O$, $H_2{}^{18}O$, and $D_2{}^{16}O$ were measured and from an analysis of the vibrational subspectra the adiabatic ionization energies for the orbitals were deduced. (auth)

8234 INFORMATION–THEORETIC ANALYSIS OF THE KINETIC INTRAMOLECULAR ISOTOPE EFFECT FOR THE F + HD REACTION. Bernstein, R.B.; Levine, R.D. (Chemistry Department, The University of Texas, Austin 78712). J. Chem. Phys. 61: No. 11, 4926-4927 (1 Dec 1974).

The information–theoretic approach to the branching ratio in reactive molecular collisions is applied to the problem of the intramolecular isotope effect for the reaction $F + HD \rightarrow HF(DF) + D(H)$. The treatment is well suited for this strongly exoergic reaction with a very small activation barrier. It is found that there is a product–state "entropy deficiency" of at least 1.7 e.u. still unaccounted for. This leads to the prediction of a large "surprisal" characterizing the (as yet unmeasured) nascent rotational state distribution of the DF product molecules. (auth)

8235 ANISOTROPIC INTERMOLECULAR POTENTIALS FROM AN ANALYSIS OF SPECTRA OF H_2– AND D_2–INERT GAS COMPLEXES. Le Roy, R.J. (Department of Chemistry, University of Waterloo, Waterloo, Ontario, Canada); Van Kranendonk, J. J. Chem. Phys. 61: No. 11, 4750-4769 (1 Dec 1974).

A method is developed for analyzing the discrete infrared absorption spectra of the van der Waals complexes formed between H_2 or D_2 and Xe, Kr, Ar, or Ne. Its application involves automatic nonlinear least squares fits of trial spectra calculated from realistic three–dimensional intermolecular potential models, to the experimental data. The secular determinant method used for calculating the energy levels of the anisotropic trial potentials proves to be highly reliable and relatively inexpensive. As a result, the present techniques should be readily applicable to cases where the anisotropic part of the potential is much stronger than it is here. The potential form used here is a Lennard–Jones (m,6) function with independent long– and short–range anisotropy coefficients, and independent parameters characterizing the effect of the stretching of the hydrogen bond on the attractive and repulsive parts of the potential. The final fits concurrently used all uniquely assigned and nonoverlapping lines of both isotopes (H_2 and D_2) of a given complex, and all parameters (except "m," which was varied manually) were allowed to vary simultaneously. The resulting potential surfaces are compared with those determined from molecular beam and relaxation time measurements. (auth)

8236 VIBRATIONAL ANALYSIS USING CRYSTALLINE MODELS: VIBRATIONAL SPECTRA AND POTENTIAL CONSTANTS FOR $Cs_2LiFe(CN)_6$. Jones, L.H.; Swanson, B.I.; Kubas, G.J. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). J. Chem. Phys. 61: No. 11, 4650-4655 (1 Dec 1974).

Single crystal Raman and infrared powder spectra have been observed for $Cs_2LiFe(CN)_6$, and for species $Cs_2LiFe(^{13}CN)_6$ and $Cs_2LiFe(C^{15}N)_6$ enriched to 94% ^{13}C and 99% ^{15}N, respectively. The infrared spectrum of the ^6Li isotopically enriched species has also been observed. The above vibrational data have been used in a normal mode calculation including interionic interaction potential constants and lattice modes. While the overdetermined A_{1g} and E_g symmetry blocks converge readily, the 6×6 F_{1u} symmetry block is ill defined. A comparison of the potential constants obtained for $Cs_2LiFe(CN)_6$ with those obtained earlier for $Co(CN)_6{}^{-3}$ shows that the M–C sigma bonding is slightly weaker for the iron complex. (auth)

8237 METAL ISOTOPE EFFECT ON METAL–LIGAND VIBRATIONS. XII. Imidazole Complexes with Co(II), Ni(II), Cu(II), and Zn(II). Cornilsen, B. C.; Nakamoto, K. (Marquette Univ., Milwaukee). J. Inorg. Nucl. Chem.; 36: No. 11, 2467-2471(Nov 1974).

Far-infrared spectra of sixteen imidazole (HIm) complexes with Co(II), Ni(II), Cu(II) and Zn(II) have been measured. Metal-ligand stretching bands have been assigned based on observed metal isotope shifts. Approximate normal coordinate analyses have been carried out on the $Zn(HIm)_2X_2$ series (X = Cl, Br and I). (auth)

8238 MERCAPTOETHYLAMINETRIACETIC ACID. Podlahova, J. (Charles Univ., Prague). Collect. Czech. Chem. Commun.; 39: No. 10, 2724-2732(Oct 1974).

Mercaptoethylaminetriacetic acid (H_3M), a complexing agent containing three kinds of donor atoms, has been studied and its acid-base dissociation constants and the dissociation mechanism have been determined. The compounds H_3M, $H_3M.H_2O$, $H_3M.HCl$, $H_3M.HCl.H_2O$ and Na_3M and their deuterated analogs were prepared and were characterized by the powder x-ray method and by their infrared spectra. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 8188, 8250, 8297, 8658, 8691, and 8980.

8239 (ORNL-4976, pp 57-62) ISOTOPE CHEMISTRY. Oct 1974.

In Chemistry Division annual progress report for period ending May 20, 1974.

Progress is reported on laser photochemical isotope separation research. Computer-calculated spectra are given for various Cl_2 isotopic molecules for the 18-0 absorption band and vibrational-rotational bands of isotopic COS molecules. Studies on the fractionation of Co and Ca isotopes by the chromatographic method continued. Results of studies on the chemical fractionation of uranium isotopes appear to eliminate any possibility that fractional desorption of UF_6 from alkali fluorides can serve as a viable process for separating uranium isotopes. The search for an economical chemical exchange process for separating sulfur isotopes continued. (JGB)

8240 (ORNL-4976, pp 146-191) CHEMICAL PHYSICS. Oct 1974.

In Chemistry Division annual progress report for period ending May 20, 1974.

A set of research programs characterized by their somewhat atomistic approach to problems is reported. These include neutron and x-ray diffraction, infrared and Raman spectroscopy, ESR spectroscopy, electron spectroscopy, and atomic and molecular collisions are given. Infrared studies of the adsorption species of water on monoclinic and tetragonal zirconium oxide as a function of temperature. D_2O exchange at 40° and 300°C produced corresponding bands for both D_2O and H_2O species. Correlations of the observed stretch frequency bands for both species are listed. The work in neutron and x-ray diffraction continues to show the complementarity of these methods in crystal structure studies, and the associated development of theoretical methods has permitted mahy complex structural determinations to be made with relative ease. An example is the structure of the charge-transfer complexing agent TCNQ which is of great interest in connection with recent studies of highly conductive organic compounds (TTF-TCNQ). Technqiues developed for the study of structure in liquids have now been used to determine the structure of amorphous ice. Electron spin resonance studies of liquids during photolysis were extended to simple peptides and there is now hope that more complex systems may be amenable. In the work on collision dynamics advances have been made in the studies of chemical reactions of electronically excited mercury, and numerous experiments designed to better define the states of energetic ions penetrating solids were carried out. (JGB)

8241 STATIC AND DYNAMIC ISOTOPE EXCHANGE SEPARATIONS ON FINELY DIVIDED PRECIPITATES IMMOBILIZED IN OPEN-CELL POLYURETHANE FOAMS. Braun, T.; Farag, A. B. (Eoetvoes Univ., Budapest). Radiochem. Radioanal. Lett.; 19: No. 4, 275-280(8 Nov 1974).

Open-cell polyurethane foam immobilizing very fine silver sulfide precipitate was prepared. The isotope exchange separation of radiosilver on the proposed Ag_2S-foam was examined in batch and column experiments. (auth)

8242 STATIC AND DYNAMIC REDOX EXCHANGE SEPARATIONS ON FINELY DIVIDED COPPER IMMOBILIZED IN OPEN-CELL POLYURETHANE FOAM. Braun, T.; Farag, A. B. (Eotvos Univ., Budapest). Radiochem. Radioanal. Lett.; 19: No. 5-6, 377-380(23 Nov 1974).

The preparation of finely divided copper immobilized in open-cell polyurethane foam was described. Static and dynamic redox exchange separation of radiosilver on the proposed copper foam was investigated. (auth)

8243 ISOTOPE EXCHANGE OF TRITIUM IN XANTHINE-WATER SYSTEM. Szydlowski, J.; Jelinska, M. (Univ., Warsaw). Radiochem. Radioanal. Lett.; 19: No. 5-6, 355-359(23 Nov 1974).

Tritium isotope exchange of C-8 proton of xanthine in the system: $[8\text{-}^3H]$ xanthine-water has been studied at several temperatures and constant pH. Preliminary mechanistic suggestions were given. (auth)

8244 DEUTERATION OF PORPHYRINS. II. Effect of the Medium on the Deuteration of Meso Position of Reduced Porphyrins. Gurinovich, I. F.; Shul'ga, A. M.; Gurinovich, G. P.; Glazkov, Yu. V. Zh. Prikl. Spektrosk.; 21: No. 4, 662-666(Oct 1974). (In Russian).

The effect of the media on the deuterium exchange of hydrogen atoms at the meso position of photoreduced etioporphyrin was studied. The sequence of the deuterium exchange in etioporphyrin molecules was shown by NMR methods. In the first place labile hydrogen atoms of the reaction centers (CH_2 groups) undergo deuterium exchange. The increase of the acidity of the medium leads to extensive deuterium exchange of the methine group not participating in the photoreduction reaction. (tr-auth)

Feed Materials Processing

Refer also to abstract 9148.

8245 (BARC-731) APPLICATION OF THE WEAK BASE ANION EXCHANGE RESIN, AMBERLITE XE-270, FOR RECOVERY OF URANIUM FROM SULPHATE LEACH SOLUTIONS: A PRELIMINARY STUDY. Kamat, K. D. (Bhabha Atomic Research Centre, Bombay (India)). 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

Amberlite XE-270, a weakly basic anion exchange resin was tested in the laboratory on a pilot-scale for the recovery of uranium from sulfate acid leach liquors. Data regarding adsorption elution and precipitation are presented and then compared with the performance of strongly basic anion exchange resin, Deacidite FF (530) currently in use at Jaduguda Uranium Mill. (auth)

8246 (PB-234691) HYDROGEN PEROXIDE PRECIPITATION OF URANIUM. Report of Investigations. Shabbir, M.; Tame, K. E. (Bureau of Mines, Washington, D. C. (USA); Bureau of Mines, Salt Lake City, Utah (USA). Salt Lake City Metallurgy Research Center). Jul 1974. 18p. (BM-RI-7931). NTIS $3.00.

A study was made to determine the optimum conditions for precipitation of uranium from mill solutions using hydrogen peroxide. Precipitation tests were made on both synthetic and actual mill solutions. Parameters studied included amount of hydrogen peroxide, initial pH, reaction pH, time, and temperature. Also investigated was the effect of varied amounts of vanadium, molybdenum, and sulfate in the test solution on uranium precipitation and product quality. The hydrogen peroxide process appeared applicable to treatment of the several mill eluate and strip solutions tested. The experimental studies also indicated that the hydrogen peroxide technique gives substantially better product quality than that produced by ammonia precipitation. (auth)

8247 HEAP AND BACTERIAL LEACHING TESTS ON SAMPLE OF LOW GRADE URANIUM ORE FROM KERUADURGRI, SINGHBHUM DISTRICT, BIHAR. Dwivedy, K. K.; Bhurat, M. C. Jayaram, K. M. V. NML (Nat. Met. Lab.) Tech. J. (Jamshedpur, India); 14: No. 2, 72-75(1972).

Samples of low grade uraniferous quartz-chlorite schist analyzing 0.043% U_3O_8, 13.0% Fe, and 0.05% S and containing indigenous ferrobacillus group of bacteria were tested for amenability to heap and bacterial leaching. A leachability of 92.8% of the contained uranium was obtained in 10 wk time using 9K nutrients for the growth of indigenous bacteria against 62.5% obtained in the same time without the use of bacteria by heap leaching method. (Indian Sci. Abstr.)

Radiation Chemistry

Refer also to abstracts 8297, 8305, 8799, 8802, 8811, 8815, 9118, 9283, and 10465.

8248 (COO-2086-68) RADIOLYSIS STUDIES ON REACTIVE INTERMEDIATES. Technical Progress Report, November 1, 1973-November 1, 1974. Kevan, L. (Wayne State Univ., Detroit, Mich. (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-2086. 18p. Dep. NTIS $4.00.

During the past year knowledge of the characteristics of ions and radicals produced by high energy radiation had advanced significantly. A model for electron transport in organic glasses and its extrapolation to liquids was developed and partially substantiated experimentally. The conduction energy level for excess electrons in liquid methane and ethane was measured and found to require modification of existing transport theory. The energy level structure and mobility of excess electrons in aqueous glasses are now understood in terms of solute ion effects. The semicontinuum model for solvated electrons was further developed to account for solvation rates in alcohols, the effect of Gaussian wavefunctions, and electron stabilization in nonpolar media. Spin trapping demonstrated that both CH_3O and CH_2OH are primary radicals in liquid methanol radiolysis and that H atoms can be trapped in γ-irradiated liquid alkanes. The thermal decay kinetics of radical pairs in irradiated solids has been delineated. Electron spin echo methods have been applied to probe the molecular dipole arrangement around trapped electrons in solids. Matrix polarity effects on recombination luminescence from electrons and cations in glasses suggest that tunneling recombination occurs in polar matrices. (auth)

8249 (ORNL–4976, pp 63–68) RADIATION CHEMISTRY. Oct 1974.

In Chemistry Divison annual progress report for period ending May 20, 1974.

Studies on the formation and decay of CN and NCO radicals in the pulse radiolysis of N_2 + CO mixtures are reported. In research on the pulse radiolysis of nitrogen and argon in the presence of NH_3, special attention is being given to the kinetics of decay of the transients, NH_2 and NH radicals. Research progress is also reported on studies on the absorption spectrum and reaction kinetics of the methylperoxy radical, the photooxidation and fluorescence of Ce(III) in aqueous H_2SO_4 solutions, and the dissociation of HSO_4^-. (TSS)

8250 RADIATION-INDUCED EXCHANGE BETWEEN BROMIDE AND BROMATE IONS. Arnikar, H. J.; Patil, S. F.; Joshi, P. P.; Prasad, S. D. (Univ. of Poona). Radiochem. Radioanal. Lett.; 19: No. 5–6, 303–314(23 Nov 1974).

An almost 100% isotope exchange between the bromide and the bromate ions in solution under γ-irradiation was observed at room temperature. Kinetic data for the radiation-induced exchange show that the rate of exchange is first order with respect to both the dose rate and the concentration of the bromate ion and independent of the concentration of the bromide ion. A mechanism is suggested consistent with the observed results. This finding is of interest in view of the fact that no thermally induced exchange was reported between these ions present in the form of their sodium or potassium salts in solution even up to 200°C. (auth)

8251 CONTRIBUTION TO THE RADIATION PREPARATION OF WOOD–PLASTIC MATERIALS. VIII. Testing of the Physical and Mechanical Properties of WPC. Varga, S.; Piatrik, M. (Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 19: No. 4, 255–261(8 Nov 1974).

Wood–plastic combinations, which were prepared by selected impregnation systems, were examined and the following properties of WPC were determined: content of polymer, density, absorption capacity, volume swelling, coefficent of swelling stability, strength in static bending, and Brinnell hardness. (auth)

8252 RADIATION CHEMISTRY OF THE AQUEOUS SOLUTIONS OF CYSTEAMINE-S-PHOSPHATE. Grachev, S. A.; Kropachev, E. V.; Litvakova, G. I. (Atomic Energy Commission, Moscow). Radiochem. Radicanal. Lett.; 19: No. 5–6, 283–295 (23 Nov 1974).

The radiolysis of deaerated neutral aqueous solutions of cysteamine-S-phosphate (cystaphos) was investigated. The main products were found to be ammonia, S-(S-thioethyl-2-amine)-thiophosphate, dithiodiphosphate and inorganic phosphate. Some part of inorganic phosphate formed during the radiolysis of cystaphos (G_{P_1} = 1.3). Additional amount of inorganic phosphate formed during the postirradiation period due to hydrolysis of S-(S-thioethyl-2-amino)-thiophosphate, dithiodiphosphate and deamination products of cystaphos (G_{P_2} = 5.9). A mechanism was proposed in order to explain the results. (auth)

8253 RADIATION GRAFT COPOLYMERIZATION OF N-VINYLPYRROLIDONE (VP) AND ACRYLIC ACID (AA) WITH CELLULOSE. Karimov, Sh. N.; Sadykov, M. U.; Azizov, U. A.; Usmanov, Kh. U. (Scientific Research Inst. of the Chemistry and Technology of Plant Cellulose, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 5, 31–33(1974). (In Russian).

Graft copolymerization of VP or AA with cellulose by irradiation with ^{60}Co in solution was found to be only 15% efficient. Actually the radiation chemical yield of free radicals in acrylic acid (G = 33) and in vinylpyrrolydone (G = 39) is somewhat greater than in cellulose, as a result of which the mass of monomer is used up on homopolymerization. Graft copolymerization from the vapor phase sharply increased the graft efficiency to 40 to 60%. (SJR)

8254 NUCLEAR COUPLING OF ^{33}S AND THE NATURE OF FREE RADICALS IN IRRADIATED CRYSTALS OF CYSTINE DIHYDROCHLORIDE. II. Charged Radicals. Hadley, J. H. Jr.; Gordy, W. (Georgia State Univ., Atlanta). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 11, 4409–4413(Nov 1974).

The ^{33}S hyperfine structure has been observed in negatively charged cystine molecule-radicals $RCH_2(SS)^-CH_2R$. The coupling, found to be axially symmetric about the SS bond, proved the orbital of the unpaired electron to be an antibonding $SS\sigma^*$ orbital with the spin density shared equally between $3p(\sigma^*)$ orbitals of the two sulfurs. The ^{33}S hyperfine structure could not be detected for a second radical produced by irradiation of the cystine hydrochloride crystal at 77°K, but interpretation of the proton hyperfine structure and g tensor observed by others led to the conclusion that this radical is the positively charged cystine molecule $RCH_2S^+SCH_2R$ with the spin density concentrated in a 3p orbital of one S and perpendicular to the SS bond. (auth)

8255 MODEL OF PRE–EXISTING TRAPS FOR ELECTRONS IN POLAR CONDENSED MEDIA. II. EFFECT OF DIPOLE–DIPOLE CORRELATION. Tachiya, M.; Mozumder, A. (Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 61: No. 10, 3890-3894 (15 Nov 1974).

A model of preexisting traps for electrons in polar condensed media is further developed. We calculate the distribution of the depth of preexisting traps taking into account the interaction between the dipoles. In this manner we consider the effect of temperature on the depth distribution. Inclusion of the dipole–dipole interaction changes the results significantly. (auth)

8256 FORMATION OF TRITIATED HYDROCARBONS DURING IRRADIATION OF HYDROCARBON TARGETS WITH T ATOMS (250 eV to 6 keV). Lagarde, G.; Paulus, J. M. (Univ. Louis Pasteur, Strasbourg). Radiochem. Radioanal. Lett.; 19: No. 5–6, 315–324(23 Nov 1974). (In French).

T atoms were allowed to strike on thick solid alkane targets (n-C_4H_{10}, i-C_4H_{10}, n-C_5H_{12}, c-C_6H_{12}) cooled at 77°K. The yields of the tritiated hydrocarbons were determined as a function of the beam energy from 250 eV to 6 keV. They are energy-independent and are close to those obtained in similar experiments with ionic beams or found by the nuclear recoil technique. (auth)

8257 CHANGE OF THE IR SPECTRA OF POLYETHYLENE UNDER THE INFLUENCE OF ELECTRON BOMBARDMENT AND GAS DISCHARGE. Borisova, M. E.; Koikov, S. N.; Korsukov, V. E.; Rubtsov, S. N. (Leningrad Polytechnic Inst.). Vysokomol. Soedin., Ser. B; 16: No. 9, 697–699(Sep 1974). (In Russian).

The change in the intensity of a series of bands in the ir spectrum of polyethylene as a result of gas discharge and electron bombardment was studied. The results showed that both during electron bombardment in a vacuum (residual gas pressure of 10^{-5} to 10^{-6} torr) and during gas discharge at atmospheric pressure, oxidation processes occur in polyethylene shown by an increase of the optical density of absorption bands associated with oxygen-containing groups. However the oxidation mechanism is different under the two conditions. In electron bombardment the most probable mechanism is the initiation of oxidation reactions by electron collision. Ozone oxidation is the most probable mechanism in gas discharge. (JSR)

8258 RADIATION-INITIATED EMULSION POLYMERIZATION OF ACRYLONITRILE. Polikarpov, V. V.; Lukhovitskii, V. I.; Pozdeeva, R. M.; Karpov, V. L. (Scientific-Research Inst. of Physical Chemistry, Moscow). Vysokomol. Soedin., Ser. A; 16: No. 10, 2207–2213(Oct 1974). (In Russian).

Gamma-initiated emulsion polymerization of acrylonitrile in the presence of cetylpyridine, K-30, and potassium laurate was studied. The dependence of the number of particles and the polymerization rate on the concentration of the emulsifier, the dose rate, and the temperature was determined. At high concentrations of a cationic emulsifier the number of particles increased as the polymerization proceeded, and in the presence of an anionic emulsifier or a low concentration of cationic emulsifier, it remained constant. From the results, a qualitative picture of emulsion polymerization of acrylonitrile is suggested, based on an occlusion theory. (tr-auth)

8259 DECOMPOSITION OF PCB BY IRRADIATION. Sawai, T. (Tokyo Metropolitan Isotope Research Center). Genshiryoku Kogyo; 19: No. 10, 29–32; 16(Oct 1973). (In Japanese).

Review is made on the dechlorination of PCB by irradiation, chain dechlorination of PCB in alkaline 2-propanol solution, dechlorination of PCB by sunlight or by heating, and problems in technical mass treatment. Generally, the chemical yield in the dechlorination by irradiation is very low. The yield is only 1-5, depending upon the conditions of irradiation. Therefore, most important thing is how to increase this yield. The irradiation of the PCB in methanol or ethanol containing sodium hydroxide or potassium hydroxide caused no change in the PCB. However, the irradiation of the PCB in 2-propanol gave white precipitates consisting of KCl or NaCl. The yield of dechlorination, G (Cl^-) was as much as 200-1,500 depending upon the concentration of alkali and PCB, the dose of irradiation, and temperature. The equivalent amount of OH^- was consumed simultaneously. Exhaustion of alkali ions in the solution stops the chain reaction. The presence of oxygen in the solution inhibited the occurrence of the chain reaction. The irradiation of the PCB in alkaline 2-propanol with ultraviolet ray from mercury lamps was also effective to dechlorinate PCB, whereas the illumination with sunlight or heating of the same sample was ineffective to cause the dechlorination. Industrial application of the method of dechlorination in 2-propanol solution is useful if PCB is present singly, however the treatment becomes difficult when PCB is mixed with various substances such as transformer oil. The separation of reaction products from 2-propanol is the second difficulty to be conquered in the future. The third is how to practice the large scale irradiation of propanol solution. (JA)

8260 GAMMA RADIOLYSIS OF 1,2-DI-IODOBENZENE. Mariano, M. H.; Bandeira, M. H. (Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares). Rev. Port. Quim. (Lisbon); 12: 112-115(1970). (In Portuguese). (LFEN-120-g).

Also available in English as report from Laboratorio de Fisica e Engenharia Nucleares, Sacavem, Portugal.

In order to detect benzyne as an intermediate product of the radiolytic decomposition of 1,2-di-iodobenzene, the behavior of this compound was studied using γ radiation from Cobalt 60 and from fission products. Biphenyl is the only reactional product; no triphenylene and biphenylene is formed. (INIS)

8261 THE EFFECT OF γ-IRRADIATION AT UBIQUINON 45 IN TRIBUTYRIN SOLUTION. Bancher, E.; Washuettl, J.; Schiffauer, R. (Technische Hochschule, Vienna (Austria). Inst. fuer Botanik, Technische Mikroskopie und Organische Rohstofflehre). Monatsh. Chem.; 105: No. 1, 71-73(Jan 1974). (In German).

Ubiquinon 45 was γ-irradiated in tributyrin solution with 0.1, 1, 10, and 50 Mrad, respectively. At 1 Mrad a clear loss of this substance was observed. Based on ir-examination the main radiolysis product may be a substance with an unchanged ring structure, but with a hydroxyl group in the side chain. (auth)

8262 EFFECTS OF IONIZING RADIATIONS ON POLYRIBOADENYLIC ACID AND ITS CONSTITUENTS, AND DEPENDENCE OF RADIOSENSITIVITY ON SECONDARY STRUCTURE. Barszcz, D.; Shugar, D. (Polska Akademia Nauk, Warsaw. Instytut Biochemii i Biofizyki). Acta Biochim. Pol.; 19: 25-42 (1972).

Radiochemical yields were determined for the destruction of adenine (G_a) and ribose (G_r) in free adenine and ribose, adenosine, adenosine monophosphates, as well as in two structural forms of polyriboadenylic acid (poly A), viz. the neutral single-stranded, and the acid twin-stranded, forms. The results were used to determine the dependence of radiation sensitivities of the various components in poly A on its secondary structure. The effect of irradiation on polynucleotide structure was followed by means of the temperature-induced helix-coil transition. Irradiations were performed in 0.005 Macetate buffer, pH 5, which is equivalent to a monoradical OH· system. The values of G_a were found to be quite uniform in all the above compounds; but G_r decreased even in the nucleoside, to attain a value more than one order of magnitude lower in acid twin-stranded poly A. In acid poly A, G_r increases with radiation dose, testifying to the influence of secondary structure on the course of radiolysis of the polymer. Temperature-induced helix-coil transition profiles of poly A made it feasible to examine the influence of relatively low doses (as low as 2 kR) on the secondary structure. Radiation-induced modifications of the structure of poly A are dependent on the conformation and the presence or absence of oxygen. Measurements of G values demonstrated that radiolysis of adenine most affected secondary structure up to doses of 10 kR. Radiolysis of ribose intervened at higher doses. The value of G_a for adenosine mononucleotides is markedly dependent on the position of phosphorylation. Phosphorylation on the $C_{(2')}$ or $C_{(3')}$ positions markedly protects adenine. Citrate buffer, commonly used as standard solvent for following helix-coil transitions in nucleic acids, was found to exhibit a pronounced radioprotective effect on poly A. This is related to radiation-induced effects on citrate, which are reflected in changes in uv absorption of the buffer. (auth)

8263 EFFECT OF IONIZING RADIATION ON THE REACTIVITY OF EPSILON-AMINO GROUPS IN TROPOCOLLAGEN. Jelenska, M. M.; Dancewicz, A. M. (Institute of Nuclear Research, Warsaw (Poland)). Acta Biochim. Pol.; 19: 341-346 (1972).

After x irradiation of tropocollagen solution in the presence of nitrogen with 30 kilorad, the content of free ε-amino groups decreased from 36 to 26 per α-chain. This decrease was but apparent and resulted from conformational changes in tropocollagen (formation of new interchain cross-linking bonds) which block the access of fluorodinitrobenzene to some free ε-amino groups. (auth)

8264 CHEMICALLY INDUCED DYNAMIC ELECTRON POLARIZATION. The Isotropic Hyperfine Coupling and the CIDEP of Radicals Produced by Pulse Radiolysis. Trifunac, A. D.; Avery, E. C. (Argonne National Lab., Ill. (USA)). Chem. Phys. Lett.; 28: No. 2, 294-296(15 Sep 1974).

Time resolved electron paramagnetic resonance spectroscopy was used to examine the electron spin polarization in several radicals produced in pulse radiolysis of aqueous alcoholic solutions. The observation of the distribution of polarized intensities in the various hyperfine lines in an EPR spectrum provides yet another indication of the $S-T_0$ mixing of the electron-nuclear states in radical pairs. (auth)

8265 CALORIMETRIC STUDY OF RADIATION POLYMERIZATION ACRYLONITRILE ABSORBED ON SILICA GEL FROM THE GAS PHASE. Kritskaya, D. A.; Ponomarev, A. N. (Inst. of Chemical Physics, Moscow). Vysokomol. Soedin., Ser. A; 16: No. 9, 2020-2023(Sep 1974). (In Russian).

The heat of gamma-initiated polymerization of acrylonitrile adsorbed on silica gel was measured by a calorimetric method. The heat was not constant but depended largely on the degree of covering of the substrate surface with the monomer. (tr-auth)

8266 INFLUENCE OF CYCLIC STRUCTURE ON THE RADIOLYSIS OF HYDROCARBONS. I. Radiolysis of Cycloheptane, Cyclooctane, and Cyclodecane. Foldiak, G.; Wojnarovits, L. (Inst. of Isotopes, Budapest). Acta Chim. Acad. Sci. Hung.; 82: No. 3, 269-284(1974).

On the basis of investigating the nearly complete product spectra of irradiated liquid cycloheptane, cyclooctane and cyclodecane, an analogy has been found between the behavior of these hydrocarbons. On comparing their radiolyses with the well-known patterns for cyclohexane and cyclopentane, it can be established that with larger rings the hydrogen yields are somewhat higher and the overall yields of products formed via C–C bond fission are somewhat lower than the corresponding values for cyclopentane and cyclohexane. Data were interpreted in terms of strain in the rings of cycloheptane, cyclooctane and cyclodecane, due to repulsion between hydrogen atoms. This repulsion favors hydrogen evolution, thus, since there is competition between the formation of products via C–H and C–C bond fission, the yields of ring fission products decrease. (auth)

8267 FRAGMENTATION PRODUCTS FROM THE ROOM-TEMPERATURE RADIOLYSIS OF LIQUID CYCLOALKANES. Foldiak, G.; Wojnarovits, L. (Inst. of Isotopes, Budapest). Acta Chim. Acad. Sci. Hung.; 82: No. 3, 305-315(1974).

A study was made of γ-irradiation with a ^{60}Co source of liquid phase cycloalkanes containing 5 to 12 carbon atoms, methylcyclopentane, ethylcyclopentane, methylcyclohexane and ethylcyclohexane. The main fragmentation products of the rings, produced by the splitting of at least two C–C bonds, are open-chain monoalkenes. On the basis of their distribution, it can be assumed that they are predominantly formed in monomolecular reactions, e.g. via biradical intermediates. In contrast, the alkane fragmentation products of the decomposition are probably generally formed in bimolecular processes. The yields of the ring-cleavage products decrease to a greater extent with the increase of the carbon atom number than do the G-values of the open-chain C_n hydrocarbons which are the main products of the C–C bond rupture. As an explanation of this phenomenon may be that the amount of energy transferred to the molecule by the radiation is independent of the molecular weight to a first approximation, consequently the energy taken by one C–C bond and so the probability of the fragmentation of hydrocarbon molecule into two or more parts is less in the case of larger molecule than for a smaller one. (auth)

8268 EFFECT OF MEDIUM ON KINETICS OF RADIATION POLYMERIZATION OF AMINOALKYL MONOMERS. Musaev,

U. N.; Karimov, A.; Tillaev, R. S.; Usmanov, Kh. U. (Tashkent State Univ.). Vysokomol. Soedin., Ser. A; 16: No. 9, 1931-1935 (Sep 1974). (In Russian).

The kinetics of radiation and photochemical polymerization of N,N-dimethylaminoethyl methacrylate and of N,N-diethylaminoethyl methacrylate were studied. The ethyl alcohol had a more rapid effect on homogeneous radiation polymerization by increasing the absolute value of k_p. With an increase in k_p and the polymerization rate, the value of E_p decreased correspondingly. (tr-auth)

8269 MICRODIPOLE MODEL FOR TRAPPED ELECTRONS IN NONPOLAR LIQUIDS AND GLASSY SOLIDS. Feng, D.; Kevan, L. (Department of Chemistry, Wayne State University, Detroit, Michigan 48202); Yoshida, H. J. Chem. Phys. 61: No. 11, 4440-4443 (1 Dec 1974).

A model is developed to treat the binding energy of excess electrons in nonpolar liquids and solids such as alkanes. Interaction of the excess electron with C—H bond dipoles is considered for several geometrical arrangements. On this basis it is found that a binding energy of about 0.5 eV can be explained for trapped electrons in condensed alkanes. Although long range polarization interactions are unimportant, the electron interaction with the bond microdipoles of a net nonpolar molecule appears to be the key to understanding electron binding in alkane matrices. (auth)

8270 ENDOR SPECTRA OF ^{14}N AND H IN FREE RADICALS FORMED BY γ–IRRADIATION OF DIMETHYLGLYOXIME SINGLE CRYSTALS. Nelson, W.H.; Atwater, F.M.; Gordy, W. (Department of Physics, Duke University, Durham, North Carolina 27706). J. Chem. Phys. 61: No. 11, 4726-4732 (1 Dec 1974).

The ENDOR spectra of the coupling nuclei in two species of radicals formed in γ–irradiated dimethylglyoxime have been measured. The more abundant of these has the form $RC(CH_3)NO$ with the unpaired electron concentrated on the NO group. This radical had been previously detected with ESR and the ^{14}N nuclear magnetic coupling measured. With the ENDOR, we obtained the more accurate values $A_1 = 130.6 \pm 0.3$ MHz, $A_2 = 73.9 \pm 1.0$ MHz, and $A_3 = 68.6 \pm 0.8$ MHz for the principal values of the magnetic coupling; in addition, we obtained the ^{14}N nuclear quadrupole couplings, $\chi_1 = -2.16 \pm 0.05$ MHz, $\chi_2 = +0.30 \pm 0.20$ MHz, and $\chi_3 = +1.92 \pm 0.20$ MHz. The g values obtained, $g_1 = 2.0026 \pm 0.0002$, $g_2 = 2.0070 \pm 0.0002$, and $g_3 = 2.0099 \pm 0.0002$, are in agreement with the earlier values. The second radical is one in which the unpaired electron interacts with two hydrogen nuclei with one set of coupling constants being $A_1 = 67.3 \pm 0.8$ MHz, $A_2 = 42.7 \pm 0.9$ MHz, and $A_3 = 19.3 \pm 0.3$ MHz, and the other set of coupling constants being $A_1 = 63.8 \pm 0.2$ MHz, $A_2 = 42.3 \pm 0.3$ MHz, and $A_3 = 22.5 \pm 0.4$ MHz. For both coupling nuclei, the eigenvectors corresponding to A_3 are perpendicular to the molecular plane. Analysis of the data shows that the radical form is $RC(NOH)CH_2$ with the $-CH_2$ group in the molecular plane. The unpaired electron is in a π orbital perpendicular to the molecular plane with 67% of the spin density on the carbon of the CH_2 group. (auth)

8271 ESR STUDY OF FREE RADICALS TRAPPED IN MECHANICALLY DESTRUCTED POLYAMIDE 6. Tino, J.; Szocs, F.; Placek, J. (Polymer Inst., Bratislava). Chem. Zvesti; 28: No. 5, 577-580(1974).

Free radicals formed from polyamide 6 during its mechanical destruction were studied. By analysis of the ESR spectra it has been elucidated that three types of free radicals, namely $-CONH\dot{C}HCH_2-$, $\dot{C}H_2CONH-$, and $\dot{C}H_2NHCO-$, are present in the system over the temperature range −50 to 0°C. The structure of these radicals as well as the proportion of their spectra in the total spectrum has been determined. (auth)

8272 ESR STUDY OF FREE RADICALS GENERATED DURING POLYMERIZATION OF VINYL MONOMERS IN POLY-(METHYL METHACRYLATE) MATRIX UNDER HIGH PRESSURE. Szocs, F.; Borsig, E.; Placek, J.; Klimova, M. (Polymer Inst., Bratislava). Chem. Zvesti; 28: No. 5, 581-586(1974).

The ESR spectra of free radicals generated during the polymerization of vinyl monomers (methyl methacrylate, butyl methacrylate, styrene, ethyl acrylate, acrylamide, vinyl acetate) initiated by thermal decomposition of benzoyl peroxide in the poly(methyl acrylate) matrix under the pressure 6000 atm were observed. The observed ESR spectra and the mechanism of the free-radical generation are discussed. (auth)

8273 ACTION OF γ RADIATION ON SOLID HALOGEN-, HYDROXYL-, AND AMMONIA-CONTAINING COMPLEXES OF PLATINUM. Breusova–Baidala, Yu. G.; Zheligovskaya, N. N.; Spitsyn, V. I. (Moscow State Univ.). Dokl. Chem.; 215: No. 4-6, 253-255(Apr 1974).

Translated from Dokl. Akad. Nauk SSSR; 215: No. 6, 1365-1368 (Apr 1974).

Dependence of radiation-chemical stability of platinum complexes on their nature (oxidation state of the central atom, nature of substituents, magnitude of the charge on the complex ion and geometrical isomerism) was studied. Solid complexes of di- and tetravalent platinum containing NH_3, Cl^-, Br^-, I^-, and OH^- in the inner sphere were subjected to gamma radiation. Results show that the chlorine and bromine complexes were the most radiation stable. (LK)

8274 ELECTRON SPIN RESONANCE STUDIES OF CHLORINE CENTRES IN IRRADIATED CHLORINE-DOPED Na_2SO_4 SINGLE CRYSTALS. Suryanarayana, D.; Sobhanadri, J. (Indian Inst. of Tech., Madras). Mol. Phys.; 28: No. 5, 1127-1138(Nov 1974).

The nature of paramagnetic centers trapped in x-irradiated Na_2SO_4 single crystals containing chlorine as impurity has been determined from ESR measurements both at room and liquid nitrogen temperatures. ClO_3, ClO_2, SO_4^- and O_3^- are the paramagnetic centers identified. The g and A parameters of ClO_3 change considerably between 298°K and 77°K. Thus the parameters of ClO_3 obtained at 298°K are $g_{xx} = 2.0123$, $g_{yy} = 2.0143$, $g_{zz} = 2.0206$ G and those of the A-tensor are $A_{xx} = 97$, $A_{yy} = 100$ and $A_{zz} = 112$ G. The parameters obtained for the same center at 77°K are $g_{xx} = 2.0132$, $g_{yy} = 2.0173$, $g_{zz} = 2.0073$ G and those of the A-tensor are $A_{xx} = 130.6$, $A_{yy} = 146.3$ and $A_{zz} = 181.2$ G. The temperature variation of the principal values is determined in the temperature range between 298°K and 77°K. These data can be interpreted on the assumption that ClO_3 undergoes libration at room temperature, which is frozen out reversibly on cooling. The structure and mechanism of these defects are discussed further. (auth)

8275 ELECTRON SPIN RESONANCE STUDIES. XLII. The Reactions of Iodine-Containing Compounds with Hydroxyl and Carbon Radicals in Aqueous Solution. Gilbert, B. C.; Norman, R. O. C.; Sealy, R. C. (York Univ., Eng.). J. Chem. Soc., Perkin Trans., II; No. 12, 1435-1441(1974).

ESR spectroscopy and pulse radiolysis with optical detection have been employed to investigate the reactions of some iodine-containing compounds with the hydroxyl radical and with some simple carbon radicals. Competition experiments and direct measurements of the variation of radical concentration with time have afforded absolute rate constants for some of these reactions, including those of iodoacetic acid with $\cdot OH$ $[5(\pm 1) \times 10^9]$, $\cdot CH_2OH$ $[2.1 (\pm 0.7) \times 10^8]$, and $\cdot CH_2CMe_2OH$ $[1.3(\pm 0.3) \times 10^7\ 1\ mol^{-1}s^{-1}]$. These data and possible reaction mechanisms are discussed. (auth)

8276 ELECTRON SPIN RESONANCE IDENTIFICATION OF THE DIMER RADICAL CATION $(CH_3O)_3P-P(OCH_3)_3^{\dagger}$ IN γ-IRRADIATED TRIMETHYL PHOSPHITE FROM SECOND-ORDER HYPERFINE STRUCTURE. Gillbro, T. (Forskningsraadens Lab., Studsvik, Sweden); Kerr, C. M. L.; Williams, F. Mol. Phys.; 28: No. 5, 1225-1232(Nov 1974).

A dimer radical possessing two anisotropically equivalent phosphorus atoms has been conclusively identified in γ-irradiated trimethyl phosphite, its ESR spectrum consisting basically of four lines due to the large second-order splitting of the central component. In the powder spectrum of the γ-irradiated glass the central features are obscured by overlapping signals from other radicals. However, the downfield (1,0) feature was clearly revealed by suppressing the formation of the interfering $P(OCH_3)_2$ radical through the inclusion of methyl bromide in the sample. The ESR spectrum of a γ-irradiated single crystal is very well resolved and three complete sets of lines can be assigned unequivocally to chemically non-equivalent dimers. The spectra of two of the dimers undergo site splitting such that the symmetry elements for each pair of magnetically distinguishable sites are related. In addition, each of the lines belonging to these two dimer spectra is flanked by a pair of "spin-flip" satellites at high microwave power. Chemical and structural evidence strongly suggests that the dimer is the centrosymmetric cation $(CH_3O)_3P-P(OCH_3)_3^{\dagger}$, the unpaired electron occupying a σ* orbital built from the 3s and 3p orbitals of the two phosphorus atoms with a p/s hybridization ratio of approximately 2. The chemical nonequivalence of the dimers may result from slight differences in this hybridization ratio. (auth)

8277 RADIOLYTIC DECOMPOSITION OF POLYCHLORINATED BIPHENYLS (PCB) IN ALKALINE 2-PROPANOL SOLUTIONS. Sawai, T. (Tokyo Metropolitan Isotope Research Center). Kogai; 7: No. 6, 248-256(Nov 1972). (In Japanese).

Studies were made on the decomposition of PCB by irradiation with ^{60}Co γ rays. Irradiation of the PCB dissolved in the neutral solution of alcohol or n-hexane did not cause any economically practicable decomposition of the PCB, whereas the irradiation of PCB in alkaline isopropyl alcohol caused efficient decomposition. $G(Cl^-)$ value reached as high as 700 at 0.08M potassium hydroxide concentration. The PCB present in transformer oil and non-carbon paper was also dechlorinated by ionizing radiation. Irradiation with ultraviolet rays was also effective for the decomposition. Presence of oxygen in the alkaline propanol interfered with the dechlorination. A 3-kCi ^{60}Co source was used to irradiate 5-ml samples placed in 20-mm-diam glass vessels. Irradiation with ultraviolet rays was made with a 10-W low pressure mercury lamp. Determination of chlorine was made by Mohr's method after collecting precipitated NaCl or KCl crystals. Analysis of the PCB was made by Shimadzu gas-chromatograph Type 4BMPE. (JA)

8278 RADIOPOLYMERIZATION OF MONOMERS IN WOODS. Esparraguera, I. Energ. Nucl. (Madrid); 18: No. 89, 157-166 (1974). (In Spanish).

In order to improve the physical-mechanical properties of Spanish woods, which do not meet minimum conditions necessary for their use in industry, radiopolymerization of monomers in wood was studied. The first materials selected for study were black poplar wood and methyl methacrylate monomer. The energy used for the polymerization of the wood-plastic combinations was γ radiation. The physical-mechanical properties of the primary materials and the techniques of impregnation and irradiation used were studied. The hardness of the product obtained was studied as a function of the polymer content which is a function of the length of impregnation. A comparative study was made between the wood-plastic combinations obtained and various species of resiniferous and woody trees. (tr-auth)

8279 EFFECT OF γ IRRADIATION ON THE SUPERMOLECULAR ORIENTATION IN POLYAMIDE FIBERS. Shaitanova, A. N.; Pismannik, K. D.; Bazhbeuk-Melikova, T. V.; Goikhman, A. Sh.; Matsibora, N. P.; Myalov, N. A. (Central-Scientific Inst. of the Cotton Industry, Moscow). Vysokomol. Soedin., Ser. B; 16: No. 10, 783-787(Oct 1974). (In Russian).

The x-ray diffraction method at large and small scattering angles was used to determine the effects of low irradiation doses (up to 50 Mrad) on the structure of polyamide fibers. The basic changes in the supermolecular orientation of the γ-irradiated polyamide fibers were determined and the possibility of directed changes in the properties of these fibers with their simultaneous sterilization was established. Very intense changes in structure, leading to a significant change in the hydrolysis process, occurs both at small (up to 3.5 Mrad) and larger (20.0 to 50.0 Mrad) doses. These average doses have a conservative effect on the structural changes in the fibers. (JSR)

8280 PULSE RADIOLYSIS OF OXYTOCIN AND LYSINE VASOPRESSIN. Klassen, N. V.; Purdie, J. W.; Lynn, K. R.; D'Iorio, M. (National Research Council of Canada, Ottawa). Int. J. Radiat. Biol.; 26: No. 2, 127-132(Aug 1974).

The reactions of e^-_{aq}, OH and H with oxytocin and lysine vasopressin have been investigated by pulse radiolysis. Reactivity was largely confined to the tyrosine, phenylalanine, and cystine residues. The cyclic radical anion $R^{\bar{}}_{SSR}$ produced by reaction with e^-_{aq} was considerably more stable than its open-chain counterpart. (auth)

8281 REACTIONS OF PHENYLALANINE DERIVATIVES, METHIONINE DERIVATIVES, AND THEIR MIXTURES IN AQUEOUS SOLUTION WITH PULSE-RADIOLYTICALLY GENERATED H ATOMS. Lichtin, N. N.; Shafferman, A. (Hebrew Univ., Jerusalem). Radiat. Res.; 60: No. 3, 432-440(Dec 1974).

Essentially the same spectrum is produced by addition of H atoms to phenylalanine, acetylphenylalanine or acetylphenylalanylamide at pH 2.0 and 6.4. This spectrum closely resembles the most prominent feature in the primary transient spectrum produced by the addition of H atoms to ribonuclease-S-peptide and can be assigned to cyclohexadienyl radicals. Specific rates of reaction of H atoms with phenylalanine, acetylphenylalanine, acetylphenylalanylamide and acetylmethionine have been determined. The decay of cyclohexadienyl radicals followed strictly second order kinetics in the absence or presence of methionyl compounds and the radicals formed by the action of H atoms upon them. No reaction of cyclohexadienyl radicals with parent methionyl compounds was detectable. The bimolecular radical-radical reactions observed with monomeric radicals take place on a time scale over which only intramolecular transformations occur in the radicals produced by the addition of H atoms to the ribonuclease-S-peptide molecule. The virtually identical reactivity of monomeric phenylalanyl and methionyl compounds to reaction with H atoms can be compared to evidence that the reaction of H atoms with ribonuclease-S-peptide takes place about five times as often at the methionyl as at the phenylalanyl residue. (auth)

8282 NITRO-CENTERED FREE RADICALS IN γ-IRRADIATED 5-NITRO-6-METHYLURACIL AT 77°K. Benson, B.; Lorenz, P. (Lehigh Univ., Bethlehem, PA). Radiat. Res.; 60: No. 3, 405-408(Dec 1974).

Gamma irradiation of 5-nitro-6-methyluracil at 77°K results in a free radical formed by hydrogen addition to an oxygen of the nitro group. The radical identity was confirmed by synthesis of ^{15}N labeled 5-nitro-6-methyluracil and observing its ESR spectra. (auth)

8283 SUPEROXIDE DISMUTASE INACTIVATION BY RADIATION-INDUCED RADICALS: EVIDENCE FOR HISTIDINE RESIDUES IN THE ACTIVE SITE. Roberts, P. B. (Inst. of Cancer Research, Sutton, Eng.); Fielden, E. M.; Rotilio, G.; Calabrese, L.; Bannister, J. V.; Bannister, W. H. Radiat. Res.; 60: No. 3, 441-452(Dec 1974).

The inactivation of superoxide dismutase from bovine and human erythrocytes brought about by ionizing radiation has been studied. Both enzymes have similar radiation sensitivities, but, whereas the solvated electron is almost completely ineffective as an inactivating species, the probabilities of an OH radical or H atom inactivating a native enzyme molecule at pH 7.2 are about 0.04 and 0.1, respectively. H atoms are more effective when the enzyme copper is in the cuprous state, suggesting a conformational difference between the two oxidation states of the enzyme. Inactivation by Br_2^- radicals is negligible at pH 7 but increases sharply above pH 10. The effect of pH upon enzyme inactivation by Br_2^- has been compared with pH effects upon the rate and product absorption spectrum of the Br_2^--enzyme reaction. In this way, Br_2^- was shown to inactivate the holoenzyme only when reaction at some histidine residues occurred. The suggestions that, in the native enzyme below pH 10, the copper protects essential histidines from damaging reactions with Br_2^- and that strong copper-histidine interactions are necessary for activity have been supported by studies on the KCN-inhibited and copper-free enzymes. (auth)

8284 ELECTROCONDUCTIVITY OF INDIUM PHOSPHIDE AND INDIUM ARSENIDE CRYSTALS IRRADIATED WITH 50 MeV ELECTRONS. Kekelidze, N. P.; Kekelidze, G. P.; Eritsyan, G. N.; Laitadze, S. L.; Milovanova, L. S.; Saakyan, V. A. (Tbilisi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 76: No. 2, 333-336(Nov 1974). (In Russian).

The electrical properties of InP and InAs crystals irradiated with 50-MeV electrons in the temperature range (77 to 3000)°K have been investigated. The temperature dependences of carrier concentration and mobility after irradiation were analyzed. The experimental data were compared with theoretical calculations based on the theory of scattering over ionized impurities and of polar lattice scattering. (auth)

8285 UNSTABLE INTERMEDIATES. CXLVII. Electron Spin Resonance Spectra of Radicals in Irradiated Organotin Compounds: The Radicals R_3Sn, R_4Sn^-, R_5Sn, R_3SnCl^-, $Ph_6Sn_2^-$, $H_2CSn(Me)_2SnMe_3$, and $H_2CSn(Me)_2Cl$. Fieldhouse, S. A.; Lyons, A. R.; Starkie, H. C.; Symonds, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Dalton Trans.; No. 18, 1966-1972(1974).

Exposure of the following compounds or their solutions to ^{60}Co γ rays at 77°K gave ESR spectra which are interpreted in terms of the radicals in parentheses: Me_4Sn ($Me_3\dot{S}n$, $Me_4\dot{S}n^-$, Me_5Sn, $H_2\dot{C}SnMe_3$); Et_4Sn ($Et_3\dot{S}n$, $Me\dot{C}HSnEt_3$, $H_2CCH_2SnEt_3$); Bu_4Sn ($Bu_3\dot{S}n$, $Et\dot{C}HCH_2SnBu_3$, $R\dot{C}HSnBu_3$); $Me_3\dot{S}nCl$ ($Me_3\dot{S}nSCl^-$, $Me_3\dot{S}n$, $H_2\dot{C}SnMe_2Cl$); Bu_3SnCl ($Bu_3\dot{S}n$, $Et\dot{C}HCH_2SnBu_2Cl$, $Pr\dot{C}HSnBu_2Cl$); Me_6Sn_2 ($Me_2\dot{S}nSnMe_3$, $H_2CSnMe_2-SnMe_3$); Ph_6Sn_2 ($Ph_6Sn_2^-$); and Ph_3SnH ($Ph_3Sn^\cdot$). Interesting aspects of these results include the pyramidal character of R_3Sn radicals and the low spin density on tin for Me_5Sn, which is thought to have D_{3h} symmetry with major spin density on the axial methyl groups. The absence of hyperfine interaction from the $\beta-Cl$ or $\beta-SnMe_3$ groups for $H_2\dot{C}Sn(Me)_2Cl$ and $H_2\dot{C}Sn(Me)_2SnMe_3$ suggests that these groups lie near the nodal plane of the half-occupied 2p (carbon) orbital, in complete contrast with the preferred conformation for the corresponding carbon radicals, $H_2\dot{C}CR_2Cl$ and $H_2\dot{C}CR_2SnMe_3$. (auth)

8286 E.S.R. SPECTRA OF X-IRRADIATED METHYLENE DIPHOSPHONIC ACID. I. Carbon Centered Radicals. Geoffroy, M.; Ginet, L.; Lucken, E. A. C. (Ecole de Chimie, Geneva). Mol. Phys.; 28: No. 5, 1289-1295(Nov 1974).

X-irradiation of single crystals of methylene diphosphonic acid gives rise to ESR spectra assigned to $(OH)_2(O)P-\dot{C}H_2$ and $[(HO)_2(O)P]_2-\dot{C}H$. The former species is the more abundant of the two and the methylene group undergoes rapid reorientation about a two-fold axis at room temperature but is stationary at 77°K. The ^1H and ^{31}P coupling constants in this radical are very similar to those in $Ph_3P^+CH_2$, and support the previous conclusion [Lucken et al., J. Chem. Soc.; A: 1074 (1966)] that there is little delocalization of the unpaired electron to the phosphorus atom. (auth)

Radiochemistry and Nuclear Chemistry

8287 SYNTHESIS OF PHOSPHOROUS–NITROGEN COMPOUNDS LABELLED WITH ^{32}P. Eckardt, A.; Seifert, S. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 10: No. 9, 333-335(Sep 1974). (In German).

$^{32}PCl_3$ and $^{32}POCl_3$ are being used as initial substances for the preparation of phosphorous-nitrogen compounds labelled ^{32}P. Chlorination of red ^{32}P yields $^{32}PCl_5$, following reduction with ^{32}P converting it into $^{32}PCl_3$, and oxidation with $KClO_3$ converting this into $^{32}POCl_3$. The following compounds labelled ^{32}P were synthesized and investigated using thin-film radiochromatography: ^{32}P phosphoroxitriamide $O^{32}P(NH_2)_3$, ^{32}P phosphoric-acid ethyl ester diamide $O^{32}P(NH_2)_2\ (OC_2H_5)$, ^{32}P phosphoric-acid diethyl ester amide $O^{32}P(NH_2)\ (OC_2H_5)_2$, ^{32}P-bis-dimethylamino-phosphoric-acid amide $O^{32}P(NH_2)\ [N(CH_3)_2]_2$, and ^{32}P-bis-diethylamino-phosphoric-acid amide $O^{32}P(NH_2)\ [N(C_2H_5)_2]_2$. (auth)

8288 PRODUCTION AND MUTUAL DELIVERY OF ISOTOPES, LABELLED COMPOUNDS, AND SEALED RADIATION SOURCES BY MEMBER COUNTRIES OF COMECON. Ertel, G. (Abteilung fuer die Friedliche Anwendung der Atomenergie, Moscow). Isotopenpraxis; 10: No. 9, 348-352(Sep 1974). (In German).

The production, export, and import of isotopes, labelled compounds, and sealed radiation sources by the members of COMECON from 1968 to 1971 are discussed and illustrated in graphic and tabular form. (JSR)

Hot-Atom Chemistry

Refer also to abstract 8154.

8289 SZILARD–CHALMERS REACTIONS IN VANADIUM ACETYLACETONE COMPLEXES. Fucugauchi de Crawley, L. A.; Cruset, A. (Instituto Nacional de Energia Nuclear, Mexico City). Radiochem. Radioanal. Lett.; 19: No. 4, 263-266(8 Nov 1974).

The retention of ^{52}V in vanadium acetylacetone complexes after the $^{51}V(n,\gamma)^{52}V$ neutron capture is shown to result mainly from an isotope exchange process. The exchange takes place on dissolving the sample and possibly in the solid state. (auth)

8290 CHEMICAL BEHAVIOR OF Zr AND Y RADIOACTIVE ATOMS FORMED BY IRRADIATING SOME FLUORINATED BETA-DIKETONATES WITH 660-MeV PROTONS. Zaitseva, N. G.; Islamova, Kh. M.; Nguyen Huynh Mai. (Joint Inst. for Nuclear Research, Dubna, USSR). Radiochem. Radioanal. Lett.; 19: No. 5-6, 361-369(23 Nov 1974).

The chemical behavior of ^{88}Zr and ^{87m}Y atoms formed in zirconium and yttrium fluorinated beta-diketonates irradiated with high energy protons has been studied using liquid chromatography and vacuum sublimation. It is shown that the yield of chelate, ligand-deficient, and inorganic forms of ^{88}Zr and ^{87m}Y depends on the type of beta-diketonate in a different way. (auth)

8291 GAS CHROMATOGRAPHIC SEPARATION OF SOME LABELLED AROMATIC HALOGEN COMPOUNDS. Berel, K.; Vasaros, L.; Kardos, Z. (Central Research Inst. for Physics, Budapest). J. Radioanal. Chem.; 21: No. 2, 419-425(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

Gas–liquid-chromatographic techniques for the separation of a large variety of mono-, di- and polysubstituted benzene derivatives from their multicomponent systems were developed for the study of reactions of recoil halogen atoms with aromatic compounds. The ^{18}F, ^{34m}Cl, ^{38}Cl, ^{82}Br, and ^{128}I labelled benzene derivatives were produced by neutron irradiations of the corresponding liquid mixtures. Because of the short half-life of most of the isotopes in question a relatively fast method was required, therefore each of the techniques described takes less than one hour to achieve the separation. (auth)

8292 PREPARATORY INVESTIGATIONS OF FAST SEPARATION FOR HEAVY ION REACTION PRODUCTS. Hoffmann, P.; Baechmann, K. (Technische Hochschule, Darmstadt, Ger.). J. Radioanal. Chem.; 21: No. 2, 389-393(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

A method for separation and chemical identification of products formed in nuclear reactions or nuclear decay is to slow down the recoil products in a gas and to transport them to a trap, where a detecting system is arranged. The sources for the recoil products are ^{252}Cf and ^{224}Ra. As transport phase we used nitrogen or argon and added chemical reagents such as methyl and ethyl radicals, chlorine, oxygen, carbon monoxide or methane. The chemical additives lead to selective and fast separation of certain elements. As examples the results of two experiments are presented: ^{224}Ra with ethyl radicals, and ^{252}Cf with chlorine–oxygen–nitrogen mixtures. The registration of the recoil products at the trap was measured as a function of temperature, pressure and composition of the reactive gas. (auth)

8293 HOT ZONE REACTIONS FOLLOWING NUCLEAR TRANSFORMATIONS IN ORGANOMETALLIC SOLIDS. Wiles, D. R. (Carleton Univ., Ottawa). J. Inorg. Nucl. Chem.; 36: No. 11, 2405-2408(Nov 1974).

The effects of nuclear recoil in organometallic compounds were studied using the reaction $^{56}Fe(n,p)^{56}Mn$, with $(CpFe(CO)_2)_2$ as target. The yields of $Cp^{56}Mn(CO)_3$ and of $-^{56}Mn(CO)_5$ were found to be very low. This is taken to mean that in this target compound recoil is not of itself important in causing the formation of organometallic molecules in nuclear reactions. The possible significance of internal conversion and of the Auger effect are considered. (auth)

Properties of Radioactive Materials

Refer also to abstracts 8156, 8164–8174, 8190, 8191, 8219, 8222, 8256, 8986, 8993, 9027, and 10379.

8294 (BARC-726) ALKALI METAL DIURANYL TRISOXALATES AND THEIR DECOMPOSITION PRODUCTS. Jayadevan, N. C.; Singh Mudher, K. D.; Chackraburtty, D. M. (Bhabha Atomic Research Centre, Bombay (India)). 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

Alkali metal salts of uranyl oxalato complexes of the general formula $M_2(UO_2)_2(C_2O_4)_3 \cdot nH_2O$ were prepared and characterized by chemical, ir, and x-ray methods. On heating in air the complexes decompose above 320°C to give alkali metal diuranates, $M_2U_2O_7$. The structural aspects of the complexes and the diuranates are discussed. (auth)

8295 (DP-MS-74-37) PARTICLE SIZE OF $^{238}PuO_2$ OBTAINED BY OXALATE PRECIPITATION AND CALCINATION. Rankin, D. T.; Burney, G. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 25p. (CONF-740947-2). Dep. NTIS $4.25.

From American Ceramic Society meeting; Williamsburg, Virginia, USA (29 Sep 1974).

The factors determining particle size distribution and morphology during precipitation of ^{238}Pu oxalate and calcination to $^{238}PuO_2$ were investigated. The manner and rate of solution addition and the rate of mixing during precipitation were the key variables in controlling particle size. A decrease in particle size of calcined $^{238}PuO_2$ with aging time was also measured. (auth)

8296 (LA-5654) PARTICLE SIZE DISTRIBUTION OF FRAGMENTS FROM DEPLETED URANIUM PENETRATORS FIRED AGAINST ARMOR PLATE TARGETS. Hanson, W. C.; Elder, J. C.; Ettinger, H. J.; Hantel, L. W.; Owens, J. W. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

Particle size distributions of fragments of depleted uranium (DU) penetrators fired against armor plate targets are described. The experiments were conducted at the request of the U. S. Air Force Armament Laboratory, Elgin Air Force Base, Florida, to provide information needed to evaluate the environmental impact of such munitions. These data will serve as input to a model for evaluation of human exposures to aerosols generated by the pyrophoric action of DU penetrators. (auth)

8297 (ORNL-4976) CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 20, 1974. Moore, G. E. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 225p. Dep. NTIS $7.60.

Each of the 7 sections were abstracted and indexed separately for NSA. The sub-sections of the section on physical chemistry were treated as individual sections. (JGB)

For abstracts of individual sections see: 8228–8230, 8239, 8240, 8249, 8298, 8299, 8324, 8336, and 10058.

8298 (ORNL–4976, pp 32-56) CHEMISTRY AND PHYSICS OF TRANSURANIUM ELEMENTS. Oct 1974.

In Chemistry Division annual progress report for period ending May 20, 1974.

Research progress is reported in the following areas of study: transfer and compound-nucleus reactions that lead to the nuclei ^{245}Cf and ^{244}Cf: interactions of ^{12}C with ^{239}Pu and ^{238}U; reactions of heavy elements with very heavy ions; decay properties and x-ray identification of ^{257}104; properties of ^{259}Rf; search for superheavy elements in lead irradiated at SLAC; search for superheavy elements in uranium target from SLAC after processing; search for superheavy elements in thorium target at Super HILAC; natural samples investigated for neutron emission; radiohalos; spectroscopy of californium bromides at elevated temperatures; the uranium M x-ray emission spectrum; nonaqueous, chemistry of lanthanides and actinides; an NMR study of the configuration of the cyclohexyl ring in the adduct of praseodymium tricyclopentadienide with cyclohexyl isonitrile; crystal structure of curium tribromide; crystallographic studies of the trifluorides and the tribromides of ^{248}Cm and ^{244}Cm; preparation of elemental ^{248}Cm and ^{249}Cf and the nitrides of ^{248}Cm and ^{249}Bk; electrochemical and spectroscopic studies of transuranic species in nonaqueous inorganic media; and, the first experimental determination of the heat of solutions of Bk metal. (JGB)

8299 (ORNL–4976, pp 115-121) PHYSICAL CHEMISTRY: INTERFACIAL PHENOMENA. Oct 1974.

In Chemistry Division annual progress report for period ending May 20, 1974.

Results are reported for an ion microprobe investigation of the surface migration of molecular oxides (La_2O_3 and SrO) on NaCl. Results of studies on the sorption of water vapor, nitrogen, and carbon dioxide on sol-gel thoria are reported. In studies on the surface chemistry of Apollo 17 lunar fines, the adsorption of nitrogen, argon, and oxygen (all at 77°K) and also of water vapor (at 20°C) was determined. (JGB)

8300 PREPARATION OF N-TOSYL-L-PHENYLALANYL-CHLOROMETHANE-1-^{14}C. Seda, J.; Sedlacek, J. (Inst. of Organic Chemistry and Biochemistry, Prague). Radiochem. Radioanal. Lett.; 19: No. 5-6, 337-341(23 Nov 1974).

A simple method has been developed for the preparation of N-tosyl-L-phenylalanylchloromethane-1-^{14}C consisting in treatment of the unlabelled N-tosyl-L-phenylalanyl chloride with diazomethane-^{14}C and affording radiochemical yields higher than 65%. (auth)

8301 SIMPLIFIED PROCEDURE FOR THE LABELLING OF THYROID HORMONES. Patel, M. C.; Desai, K. R.; Mehta, M. N.; Glenn, H. J. (Bhabha Atomic Research Centre, Bombay). Int. J. Appl. Radiat. Isotop.; 25: No. 9, 421-422(Sep 1974).

An easy procedure for making radio-iodine labelled thyroid hormones in high specific activities is described. The technique is based on the principle of isotopic exchange between an iodine atom of the tracer Na^{125}I or Na^{131}I and that of ^{127}I of the thyronine molecule in the prime position as described by Gleason [J. Biol. Chem.; 213: 837 (1955)]. The present method was modified from that originally described by Gleason by adopting the Hunter Greenwood technique (Biochem. J.; 89: 114 (1962)), so as to yield high specific activity triiodothyronine (T-3) of excellent purity. The factors on which the yield and quality depends are discussed. The results reported suggest that in the procedure exchange between the iodine of the tracer and that of the thyronine molecule used is a primary event. (UK)

8302 QUALITY CONTROL OF RADIOPHARMACEUTICALS. XIV. Sodium ^{123}I-Iodide. Neirinckx, R. D.; Lambrecht, R. M.; Norton, E. F.; Wolf, A. P. (Brookhaven National Lab., Upton, NY). Int. J. Appl. Radiat. Isotop.; 25: No. 9, 387-392(Sep 1974).

The radionuclidic purity, the radiochemical composition, and a chemical analysis of tellurium and carrier iodine in sodium iodide-123 were determined. The Na^{123}I was obtained from (1) two commercial sources; (2) by cyclotron methods in routine "in house" use; and (3) a promising spallation reaction method. The radiation dose to the patient is discussed in relationship to the quality of the sodium ^{123}I-iodide. (auth)

8303 REFERENCE MEASUREMENT OF THE SPECIFIC ACTIVITY OF A ^{90}Sr/^{90}Y SOLUTION, PERFORMED BY ASMW OF BERLIN AT WNIIM OF LENINGRAD. Brust, R. (Fachabteilung Ionisierende Strahlung, Berlin); Schoenfeld, E.; Greupner, H.; Kotschin, A. E.; Karavajev, F. M. Isotopenpraxis; 10: No. 9, 326-329(Sep 1974). (In German).

An international reference measurement is reported, which was carried out by the participating establishments in order to check the accuracy of their standard metering devices serving for the determination of the activity unit of beta-active nuclides. Various correction factors and methods of their determination are discussed. The difference in the result is 0.7%, thus ranging within the given margins of error. (auth)

8304 CESIUM SALTS OF TITANIUM, ZIRCONIUM, AND THORIUM CYANOFERRATES(II). Kourim, V.; Laznicek, M.; Dolezal, J. (Nuclear Research Inst., Rez, Czech.). J. Radioanal. Chem.; 21: No. 2, 355-362(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The synthesis of cyanoferrates of quadrivalent metals and the sorption of cesium ions by these materials were studied. Compositions of the compounds and their properties are strongly influenced by the degree of hydrolysis of the metal. There is no sorption of cesium by Zr^{4+} and Th^{4+} cyanoferrates, while the compounds of oxygen-containing bivalent complex cations exhibit behavior similar to that of the other bivalent metals. The sorption of cesium by $(TiO)_2R$ is governed by an ion-exchange mechanism; with $(ZrO)_2R$ changes occur in the crystal lattice, and $(ThO)_2R$ exhibits a low affinity towards cesium. (auth)

8305 COLLOIDAL FORMS OF RADIONUCLIDES AND THEIR SEPARATION FROM WATER SOLUTION. Kepak, F. (Nuclear Research Inst., Rez, Czech.). J. Radioanal. Chem.; 21: No. 2, 489-495(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

Colloidal properties of ^{144}Ce(III), ^{147}Pm(III), ^{91}Y(III), and other radionuclides were determined from the course of their self-diffusion. A reduced self-diffusion indicated the formation of colloidal radionuclides. The decrease in the self-diffusion coefficient began from a certain value of pH, and a pH region of slowest self-diffusion existed for each of the radionuclides studied. The maximum formation of colloidal radionuclides may be assumed to lie in the range of these pH values. An increase in the rate of self-diffusion was observed with radionuclides in colloidal forms under the effect of gamma radiation. The possibility of mutual interaction between radionuclides was also inferred from the course of their self-diffusion. High effective sorption of ^{147}Pm(III) was attained on hydrated ferric oxide in the pH range where hydrolytic products and colloidal forms of ^{147}Pm(III) were formed to a large extent. (auth)

8306 RADIOCHEMICAL STUDY OF HYDROLYZABLE CARBIDES. Hajek, B. (Inst. of Chemical Tech., Prague); Brozek, V.; Matucha, M.; Popl, M.; Mostecky, J. J. Radioanal. Chem.; 21: No. 2, 407-410(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

A simple radiochemical method was developed for the phase analysis of hydrolyzable carbides. The method is based on the radio gas chromatography of gaseous products of carbide hydrolysis with simultaneous mass and activity detection. The tritium-labelled hydrocarbons evolved (tritium oxide used for hydrolysis) are characteristic of the individual carbide phases. An application for Group III b carbide phase analysis is demonstrated. (auth)

8307 IMMOBILIZED ENZYMES IN THE PRODUCTION OF RADIOPHARMACEUTICALLY PURE AMINO ACIDS LABELED WITH ^{13}N. Cohen, M. B.; Spolter, L.; Chang, C. C.; MacDonald, N. S.; Takahashi, J.; Bobinet, D. D. (Veterans Administration Hospital, Los Angeles). J. Nucl. Med.; 15: No. 12, 1192-1195 (Dec 1974).

Nitrogen-13 and ^{11}C-labeled compounds may be obtained by enzymatic synthesis but the frequent presence of potentially pyrogenic and antigenic enzymes in the final product creates problems of radiopharmaceutical purity. This report describes methods for the synthesis of pharmaceutical-quality ^{13}N-labeled amino acids by binding the required enzymes to a solid-state support. Nitrogen-13-L-glutamic acid was synthesized on stream by using glutamic acid dehydrogenase which had been immobilized on porous derivatized (N-hydroxysuccinimide) silica beads and packed into a column. Nitrogen-13-L-alanine was synthesized by adding pyruvate to ^{13}N-L-glutamic acid and passing this mixture through a second column of similar silica beads containing the immobilized enzyme glutamic-pyruvic transaminase. (auth)

8308 THERMOGRAVIMETRIC STUDIES OF UO_2-SiO_2. Prodan, A.; Cojocaru, L. N. (Institutul de Fizica Atomica, Bucharest (Romania)). J. Nucl. Mater.; 52: No. 2, 333-335 (Oct 1974).

The loss or gain of oxygen in UO_2, SiO_2 and UO_2-SiO_2 samples was measured in the temperature range from 100 to 1000°C. In order to determine the activation energy for diffusion it was assumed that isothermal diffusion in the oxides is similar to the diffusion of oxygen through the samples after neutron irradiation. The defects, i.e. the oxygen vacancies, may be annealed by oxygen atom diffusion. (auth)

8309 SOME CHARACTERISTICS OF JOINT CARBOTHERMIC REDUCTION OF THE OXIDES OF URANIUM AND NIOBIUM. Kiselev, V. A.; Vlasov, V. G.; Kazanbaev, L. A. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 5, 1157-1159(May 1974).

Translated from Zh. Prikl. Khim.; 47: No. 5, 1135-1137(May 1974).

A study of joint carbothermic reduction of the oxides Nb_2O_5 and UO_2 is reported. The mechanism of the reduction and whether UC–NbC solid solutions can be formed directly in the reduction process are considered. (LK)

8310 URANYL CARBONATE FORMATION UNDER NORMAL CONDITIONS. Urbanec, Z.; Cejka, J. (Institut fuer Kernforschung, Prague). Collect. Czech. Chem. Commun.; 39: No. 10, 2891-2910(Oct 1974).
GE.

By use of chemical, thermal, and x-ray phase analyses and infrared spectroscopy, the phase obtained by saturation of aqueous suspensions of α-$UO_3 \cdot 2H_2O$ with CO_2 was prepared. The phase had the composition $UO_3 \cdot 0.80CO_2 \cdot 1.06H_2O$ at normal temperature and pressure. It was isolated as an intermediary product in the synthesis of the uranyl carbonates $UO_2CO_3 \cdot xH_2O$. α-$UO_3 \cdot 2H_2O$ was obtained by oxidation of the aqueous suspensions of $UO_{2.88} \cdot 1.5H_2O$ with oxygen. A comparison was made of the phases with the general composition $[UO_2(CO_3)_{1-x}(OH)_{2x}] \cdot yH_2O$ or $[UO_2(CO_3)_{1-x}(\cdot OH)_{2x}]$, which were prepared at normal temperature or under hydrothermal conditions and with secondary uranium minerals. Their infrared spectra were obtained. The products of the long-lasting hydrolysis of these phases under laboratory conditions and at increased temperatures were discussed. (tr-auth)

8311 PICOLINE-2-ALDEHYDE THIOSEMICARBAZONE. Leggett, D. J.; McBryde, W. A. E. (Waterloo Univ., Ontario). Talanta; 21: No. 10, 1005-1011(Oct 1974).

The acid association constants for picoline-2-aldehyde thiosemicarbazone have been determined by potentiometry and spectrophotometry. Results are calculated by the modified computer programs SCOGS and PITMAP. Protonation sites are suggested for these reactions. A spectrophotometric survey was performed of the reaction between PATS and several metal ions. Th(IV) was among those studied. (auth)

8312 KINETICS OF OXIDATION OF URANIUM(IV) IN SULPHURIC ACID BY MOLECULAR OXYGEN. Juznic, K.; Fedina, S. (Nuklearni Inst. Jozef Stefan, Ljubljana, Yogoslavia). J. Inorg. Nucl. Chem.; 36: No. 11, 2609-2610(Nov 1974).

A study is presented of the kinetics of oxidation of uranium(IV) by molecular oxygen in sulfuric acid, as a function of acid concentration, of partial pressure of oxygen, and of temperature. The results are compared with those for the oxidation of uranium(IV) ions in perchloric acid and the reason for differences discussed. (UK)

8313 KINETIC STUDY OF THE REDUCTION OF AMERICIUM(VI) BY HYDROGEN PEROXIDE IN AQUEOUS PERCHLORATE MEDIA. Woods, M. Sr.; Cain, A. (Rosary Coll., River Forest, IL). J. Inorg. Nucl. Chem.; 36: No. 11, 2605-2607(Nov 1974).

The empirical form of the rate law for the reduction of Am(VI) by hydrogen peroxide in aqueous perchlorate media at 25°C and $I = 1.00$ M is $-d[Am(VI)]/dt = k[Am(VI)][H_2O_2]$. Over the range of hydrogen-ion concentration from 0.98 to 0.01 M, $\log k = 4.592 \pm 0.007 - 0.12 \pm 0.01 \log[H^+]$. These results are compared with those obtained using the iso-structural Np(VI) and Pu(VI) ions. (auth)

8314 PREPARATION OF ^{3}H-LABELLED ALCOHOLS BY REDUCTION OF CARBONYL COMPOUNDS WITH LITHIUM BOROHYDRIDE PARTIALLY HYDROLYSED WITH TRITIATED WATER. Cornforth, R. H. (Shell Research Ltd., Sittingbourne, Eng.). Tetrahedron; 30: No. 21, 3933-3934(Nov 1974).

$LiBH_4$ partially hydrolyzed with tritiated water in THF solution reduces carbonyl compounds (octanal, methyl octanoate, phenylacetaldehyde) to ^{3}H-labelled alcohols with a negligible amount of exchange of hydrogen in the α-position provided there is no additional activation of this position. The labile methylene H atoms of phenylacetaldehyde suffer about 2% exchange during reduction. (auth)

8315 EQUILIBRIA IN COMPLEXATION REACTIONS BETWEEN THORIUM(IV) AND POLYDENTATE LIGANDS. Nayan, R.; Dey, A. K. (Allahabad Univ., India). J. Inorg. Nucl. Chem.; 36: No. 11, 2545-2548(Nov 1974).

Chelation reactions of thorium(IV) with 3,3′-bis[N,N′-di(carboxymethyl)aminomethyl]-o-cresolsulfonphthalein (xylenol orange: DCAC) and 1-(o-arsonophenylazo)-2-naphthol-3,6-disulfonic acid (thorin; APANS) were investigated in aqueous media at 35°C at an ionic strength of 0.1 M (KNO_3) employing a pH-titration technique. Evidence is presented of the formation of the monoprotonated 1 : 1 metal-ligand species. These species liberate hydrogen ions at pH ≈ 4.5, and finally the nonprotonated species interacts with hydroxyl ions to form mono- and dihydroxo species. The equilibrium constants were evaluated, and the probable coordination sites of ligands involved in the complexes are suggested. (auth)

8316 KINETICS AND MECHANISM OF THE REACTION OF U(VI) WITH Eu(II). Ekstrom, A.; Johnson, D. A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Inorg. Nucl. Chem.; 36: No. 11, 2557-2562(Nov 1974).

The kinetics of the reduction of U(VI) by Eu(II) according to the reaction U(VI) + Eu(II) → U(V) + Eu(III) have been studied. The reaction is first order with respect to both reagents and independent of the acid concentration. The values of ΔS^* and ΔH^* for the reaction are -34.4 ± 0.1 cal deg^{-1} mol^{-1} and $(1.50 \pm 0.28) \times 10^{-3}$ cal mol^{-1}, respectively. The reaction rate is unaffected by the addition of 2×10^{-2} M Cl^- ion but is catalyzed by the addition of similar concentrations of SO_4^{2-} ions. Reaction mechanisms consistent with the observed results are discussed. (auth)

8317 MOESSBAUER EMISSION SPECTROSCOPY OF ^{119}Sb-LABELLED ANTIMONY(III) OXIDE, SULPHATE, AND HALIDES. Llabador, Y. (CNRS, Strasbourg). J. Inorg. Nucl. Chem.; 36: No. 11, 2453-2457(Nov 1974).

The after-effects of the ^{119}Sb EC decay have been investigated by Mössbauer emission spectroscopy in several Sb(III) inorganic compounds: Sb_2O_3, $Sb_2(SO_4)_3$, SbF_3, $SbCl_3$, $SbBr_3$ and SbI_3. Variable amounts of $^{119}Sn^{2+}$ and $^{119}Sn^{4+}$ are formed. The results are discussed in terms of crystal structures and Sn–X bond energies. (auth)

8318 KINETICS AND MECHANISM OF THE REACTION OF U(VI) WITH 4-(2-PYRIDYLAZO)RESORCINOL (PAR). Ekstrom, A.; Johnson, D. A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Inorg. Nucl. Chem.; 36: No. 11, 2549-2556(Nov 1974).

The kinetics of the reaction between U(VI) and 4-(2-pyridylazo)-resorcinol (PAR) have been studied. The rate of reaction is first order with respect to the U(VI) and PAR concentrations but inversely proportional to the acid concentration, and it is concluded that the predominant reaction path involves reaction between UO_2^{2+} ions and the molecular form of PAR. The spectral and fluorescence properties of PAR and other structurally similar compounds provide conclusive evidence for the presence of tautomeric forms of both the protonated and molecular forms of PAR in aqueous solution. (auth)

8319 TETRAOXALATO COMPLEXES OF URANIUM(IV) – $M_2U(C_2O_4)_4 \cdot nH_2O$. Awasthi, S. K.; Chawla, K. L.; Chackraburtty, D. M. (Bhabha Atomic Research Center, Bombay). J. Inorg. Nucl. Chem.; 36: No. 11, 2521-2523(Nov 1974).

The preparation and characterization of tetraoxalato complexes of uranium(IV) with Ca, Sr, Ba, Cd and Pb are described. Thermal analysis, IR, and magnetic properties have been studied and the mixed oxides formed on heating identified by the x-ray diffraction method. The magnetic moment of $Ba_2U(C_2O_4)_4 \cdot 8H_2O$ is 3.60 B.M. with $\theta = 135°$. The results are discussed. (auth)

Radioactive Waste Treatment

8320 (BARC-744) AEROSOL FILTRATION CHARACTERISTICS OF SAND. Part I. Kapoor, J. C.; Subramanian, K. G.; Khan, A. A. (Bhabha Atomic Research Centre, Bombay (India). Desalination and Effluent Engineering Div.). 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

A study of filtration characteristics of sand was undertaken to evaluate its suitability for use in a reactor containment system under accidental and emergency conditions. As a first step, the pressure drop characteristics were investigated and the experimental results of the study are given. An equation for the pressure drop (ΔP) of the sand filter was developed and a comparison of the calculated values of pressure drop and the observed values was made. (auth)

8321 (BARC-745) AEROSOL FILTRATION CHARACTERISTICS OF SAND. Part II. Kapoor, J. C.; Subramanian, K. G.; Khan, A. A. (Bhabha Atomic Research Centre, Bombay (India)). 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

The collection efficiency characteristics of sand were studied and an empirical relation developed for this parameter as a function of grain-size of sand and the bed-depth. Dust holding capacity has also been studied theoretically as well as experimentally. Effect of deaeration of sand-grains, face-velocity and direction of flow of gases was also investigated. (auth)

8322 (CONF-730915–16) GENERAL SURVEY OF TECHNIQUES FOR SEPARATION AND CONTAINMENT OF NOBLE

GASES FROM NUCLEAR FACILITIES. Bendixsen, C. L.; Buckham, J. A. (Allied Chemical Corp., Idaho Falls, Idaho (USA)). 1973. 13p. Dep. NTIS $4.00.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

Radioactive noble gases produced during uranium fission constitute a waste material requiring special treatment and handling techniques if releases to the environment are to be reduced or minimized. To date, treatment has been confined to short-term holdup of nuclear reactor off-gases, to allow short half-life fission products to radiolytically decay. Although the required degree or efficiency of noble gas separation and containment is not yet determined, considerable development effort has been expended on a variety of separation processes. With some separation processes, the technology is advanced sufficiently that commercial separation units are now being offered for sale. Early installations of these will be mainly at reactors where their prime advantage is a reduction in size of the holdup system required and an increase in the holdup time for radiolytic decay. Eventually, separation processes may have to be installed at nuclear fuel reprocessing facilities to collect the long-lived krypton-85. (auth)

8323 (DP-MS-74-45) CHEMICAL CHARACTERIZATION OF SRP WASTE TANK SLUDGES AND SUPERNATES. Gray, L. W.; Ondrejcin, R. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 22p. (CONF-741042-1). Dep. NTIS $4.25.

From 8th conference on analytical chemistry in nuclear technology and exhibition; Gatlinburg, Tennessee, USA (22 Oct 1974).

Most high-level wastes at SRP are byproducts of plutonium and enriched uranium recovery processes. The high-level waste generated by these separations processes is stored in large, underground, carbon steel tanks. The waste consists of: supernate [an aqueous solution of Na^+, NO_3^-, NO_2^-, OH^-, $Al(OH)_4^-$], sludge [a gelatinous material containing insoluble components of the waste such as $Fe(OH)_3$, $Al(OH)_3$, HgO, and MnO_2], and salt cake (crystals such as $NaNO_3$ formed by evaporation of water from supernate). Analyses of SRP wastes by laser-Raman spectrometry, atomic absorption spectrometry, spark source mass spectrometry, and colorimetry are discussed. These analyses are useful in studies of waste tank corrosion and of forms for long-term waste storage. (auth)

8324 (ORNL–4976, pp 75-102) PHYSICAL CHEMISTRY: AQUEOUS SYSTEMS. Oct 1974.

In Chemistry Division annual progress report for period ending May 20, 1974.

Research progress on the following topics is reported: problems encountered in deriving activity coefficient values from data on mixed electrolyte systems; the standard potential of the Ag, AgBr electrode in DBr solutions; the hydrolysis of cations: a critical review of hydrolysis species and their stability constants in aqueous solution; phosphoric acid dissociation equilibria in aqueous solutions to 300°C; high-temperature equilibria in light and heavy water; ^{19}F NMR studies on fluoroborate species in aqueous solution; studies on the vaporization of methylmercury compounds and their halogen decomposition using gas chromatography with a microwave detector; liquid-vapor critical temperatures of aqueous electrolyte solutions and several aqueous-organic and organic-organic solutions systems; Debye-Hückel correlated solubilities of $CaSO_4$ in water and in aqueous sodium nitrate and lithium nitrate solutions; $CaSO_4$ solubility in brackish water concentrates and applications to hyperfiltration (reverse osmosis), polyphosphate additives; advanced filtration of waste waters; adsorption of inorganic materials on uncharged polystyrene–DVB copolymers; adsorption of inorganic materials on activated carbon; and, extraction of Li from neutral salt solutions with fluorinated β-diketones. (JGB)

8325 RETENTION OF IODINE FISSION PRODUCTS ON IODIDE PRECIPITATES. Csada, G. I. (Central Research Inst. for Physics, Budapest); Gimesi, O.; Banyai, E.; Oerdoegh, M. J. Radioanal. Chem.; 21: No. 2, 427-435(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

A fast and selective method was developed for the separation of the iodine fission products in the primary cooling water of nuclear reactors. The parameters of the selective retention were studied on silver, thallium(I) and mercury(II) iodide. Retention experiments were performed on adequately thick layers of "free" precipitates and on precipitates fixed in filter paper. The latter method substantially increases the retention capacity. The papers with fixed precipitate are easy to handle. The filter paper with silver iodide precipitate was found to be the most satisfactory for the selective retention of fission iodine from reactor water. (auth)

8326 IMPROVED INORGANIC ION-EXCHANGERS. I. Systems with Organic Polymers and Binding Materials. Stejskal, J.; Soukup, J.; Dolezal, J.; Kourim, V. (Nuclear Research Inst., Rez, Czech.). J. Radioanal. Chem.; 21: No. 2, 371-379(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The use of organic polymers as binding agents for inorganic ion-exchangers was studied. Poly-vinyl acetate and polystyrene polymers were applied to ammonium phosphomolybdate and zinc ferrocyanide. The method of preparation and hydromechanical properties of the resulting materials in ion-exchange columns are described. The materials were used for cesium removal from simulated Purex high-level radioactive waste solutions. The break-through capacities and results of repeated sorption-elution cycles are presented. (auth)

8327 IMPROVED INORGANIC ION-EXCHANGERS. II. Ammonium Molybdophosphate–Silica Gel System. Dolezal, J.; Stejskal, J.; Tympl, M.; Kourim, V. (Nuclear Research Inst., Rez, Czech.). J. Radioanal. Chem.; 21: No. 2, 381-387(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The possibility of using the sol-gel method for preparation of inorganic ion-exchangers with a silica gel matrix was demonstrated on the ammonium molybdophosphate–silica gel (AMP–SG) system. For the preparation of the ion-exchanger a sodium silicate solution, containing AMP and components to cause gelling to silica gel after increase of the temperature of the solution, is poured into a hot stirred silicone oil. The solution forms droplets, which are filtered off after their gelling, washed, and dried. Beads containing 65 wt % of AMP per gram of dry material were prepared by this method and tested in ion-exchange columns for cesium removal from nitric acid solutions. Cesium may easily be desorbed with ammonium chloride or nitrate solutions. The ion-exchanger is suitable for long-time reversible column operation, having not only good chemical, thermal, and radiation stabilities but also good mechanical and hydrodynamic properties and resistance to abrasion. It combines the advantage of the good kinetics of ion-exchange obtained with microparticles of precipitated inorganic ion-exchanger, with the low flow resistance of large particles. (auth)

Radioisotope Production

8328 SEPARATION OF ARSENIC-77 IN A CARRIER-FREE STATE FROM THE PARENT NUCLIDE GERMANIUM-77 BY A THIN-LAYER CHROMATOGRAPHIC METHOD. Maki, Y. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan); Murakami, Y. J. Radioanal. Chem.; 22: No. 1-2, 5-12 (1974).

^{77}As(III) and ^{77}As(V) were separated from neutron-irradiated GeO_2 by a thin-layer chromatographic method, in which silica gel was used as adsorbent and a 2:1 mixture of methanol and 5N HCl as developer. The Rf values of these nuclides were as follows: 0.00 for ^{77}Ge, 0.50 for ^{77}As(III) and 0.94 for ^{77}As(V). The influence of As(III) carrier added before the separation was investigated on the oxidation state of ^{77}As recoiled from the parent nuclide. The radiochemical purity of ^{77}As thus separated was more than 99.9% and the activity due to ^{77}As could easily be eluted with water from the adsorbent, with 93% recovery. (auth)

8329 TECHNETIUM-99M GENERATORS. Charlton, J. C.; Lyons, D. (to Radiochemical Centre Ltd.). British Patent 1,361,988. 31 Jul 1974. 7p.

^{99m}Tc is available commercially in the form of a generator consisting of an ion exchange column of Al_2O_3 carrying ^{99}Mo in the form of adsorbed molybdate ions. The ^{99m}Tc may be eluted from such columns at intervals in the form of pertechnetate ions. ^{99m}Tc generators in common use are usually eluted with saline solution containing NaCl in sterile pyrogen-free water, and yields are generally satisfactory (~80%) provided the activity of the ^{98}Mo parent is below a certain level; above this level, however, the yields are frequently lower and are liable to fluctuate widely. The cause of this irregularity is believed to be reduction of the pertechnetate ions by reducing species produced in the column by radiation action. The reduced ^{99m}Tc species remains firmly adsorbed on the column, with consequent reduction of the yield. Methods of overcoming this problem are described. In the method described the aqueous saline solution contains at least 10^{-7} M concentrations of nitrate or nitrate ion, and examples are given for the production of generators of at least 100 mCi activity. The action of the nitrate or nitrate ions is to oxidize hydrated electrons that act as reducing species, and to reoxidize reduced Tc. (UK)

8330 SEPARATION OF TRACE IMPURITIES OF ^{131}I FROM ^{99}Mo OBTAINED BY EXTRACTION FROM FISSION

PRODUCTS OF URANIUM. Deptula, C.; Kulesza, A.; Wiza, J. (Inst. of Nuclear Research, Swierk, Poland). J. Radioanal. Chem.; 21: No. 2, 319-323(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The radioisotope ^{99}Mo was separated from a mixture of ^{235}U fission products in the presence of Hg^{2+} by sorption on a chromatographic column filled with Al_2O_3 and elution with 1M NH_4OH. Trace impurities of ^{131}I in the molybdenum fraction were eliminated by selective sorption on silver iodide or by repeated sorption of ^{99}Mo on Al_2O_3. (auth)

8331 SEPARATION OF ^{113m}In FROM ^{113}Sn ON AN ISOTOPE GENERATOR WITH INORGANIC IONITE. Deptula, C.; Kulesza, A.; Wiza, J. (Inst. of Nuclear Research, Swierk, Poland). J. Radioanal. Chem.; 21: No. 2, 325-329(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

A method of preparation of hydrated zirconium oxide suitable for ^{113m}In generators was elaborated. A good separation of ^{113m}In from ^{113}Sn was obtained in the course of routine use of a generator, with a very small admixture of zirconium in the eluate. (auth)

8332 RECENT PROGRESS OF RADIOPHARMACEUTICALS. Preparation of Short-Lived Radioactive Compounds and their Utilization. Ogawa, H. (Daiichi Radioisotope Labs., Ltd., Tokyo). Radioisotopes (Tokyo); 23: No. 3, 198-205(Mar 1974). (In Japanese).

The preparation of short-lived radioactive compounds and their utilization are described. As most radioisotopes have been imported in Japan, it was actually difficult to use radioisotopes with a half-life of less than 2 days. However some of them can be imported in a form of parent nuclide and kept, and only daughter nuclides can be taken out by use of a generator, if necessary. The ^{99}Mo–^{99m}Tc generator is the most famous one, by which ^{99m}Tc solution with very high specific radioactivity is obtained. In order to prepare ^{99m}Tc labeled compounds, various reagent kits (^{99m}Tc–MAA kit, ^{99m}Tc-pyrophosphate kit, ^{99m}Tc-albumin kit etc.) are employed. Labeling methods and utilizations of each kit are examined, and animal experiments are performed to study distribution and accumulation of each radioactive compound in the organs. In addition ^{113}Sn–^{113m}In generator and the reagent kits for ^{113m}In are explained. Radioisotopes made by cyclotrons (^{67}Ga and ^{111}In) and those made in Japan (^{18}F and ^{123}I) are also mentioned. (JA)

Reactor Fuel Reprocessing

Refer also to abstracts 8202, 8612, and 8984.

8333 (BARC-734) COUNTER-CURRENT EXTRACTION STUDIES FOR THE RECOVERY OF NEPTUNIUM BY THE PUREX PROCESS. Part I. Srinivasan, N.; Nadkarni, M. N.; Kumar, S. V.; Kartha, P. K. S.; Sonavane, R. R.; Ramaniah, M. V.; Patil, S. K. (Bhabha Atomic Research Centre, Bombay (India)). 1974. 35p. Dep. NTIS (US Sales Only) $4.75.

It is proposed to recover neptunium-237, along with uranium and plutonium, during the fuel reprocessing in the PREFRE Plant at Tarapur. Counter-current extraction studies, relevant to the codecontamination (HA) and partitioning (IA) cycles of the Purex process, were carried out to arrive at suitable chemical flowsheet conditions which would enable the coextraction of neptunium along with uranium and plutonium. The results of the studies carried out using a laboratory mixer-settler unit and synthetic mixtures of neptunium and uranium are reported here. Based on these results, the chemical flowsheet conditions are proposed for the coextraction of neptunium even if it exists as Np(V) in the aqueous feed solution. (auth)

8334 (BARC-735) COUNTER-CURRENT EXTRACTION STUDIES FOR THE RECOVERY OF NEPTUNIUM BY THE PUREX PROCESS. Part II. Srinivasan, N.; Nadkarni, M. N.; Kumar, S. V.; Kartha, P. K. S.; Sonavane, R. R.; Ramaniah, M. V.; Patil, S. K. (Bhabha Atomic Research Centre, Bombay (India)). 1974. 37p. Dep. NTIS (US Sales Only) $5.00.

Counter-current extraction experiments were carried out under the conditions relevant to the partitioning column (IBX) in the Purex process to know the path of neptunium present as Np(VI) the organic phase during the partitioning step. The results obtained show that when ferrous sulfamate is used as the reducing agent, most of the neptunium continues to remain with uranium in the organic stream, while with hydrazine-stabilized uranous nitrates as the reducing agent, a major fraction of neptunium follows the aqueous stream. Mixer-settler experiments were also carried out under the conditions relevant to the uranium purification cycle (2D) to establish the conditions for forcing neptunium to the aqueous raffinate or for partitioning it from uranium if both neptunium and uranium are coextracted in this cycle and the results obtained are reported here. (auth)

8335 (DOCKET-50201-156) WEST VALLEY REPROCESSING PLANT. Safety Analysis Report, Supplement 9. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 30 Sep 1974. 112p. Dep. NTIS $8.75.

Supplement 9 includes responses to USAEC comments and questions on criticality contained in the USAEC letter to NFS dated June 28, 1974, and revised pages of the Safety Analysis Report which incorporate information presented in the responses. (LK)

8336 (ORNL-4976, pp 121-145) PHYSICAL CHEMISTRY: MOLTEN SALTS. Oct 1974.

In Chemistry Division annual progress report for period ending May 20, 1974.

Progress in studies on the oxide chemistry of Nb(V) in molten $LiF-BeF_2$ mixtures is reported. A phase diagram representing the NbO_2F and NiF_2 concentrations in molten $LiF-BeF_2$ at 600°C as a function of the oxide phases present at equilibrium is given. Reactions corresponding to each of the three-phase equilibria (two oxide phases and the molten fluoride phase) are listed. A Pourbaix diagram for Nb in $LiF-BeF_2-ThF_4$ at 600°C is illustrated. Studies on competitive hydration and association equilibria in hydrous melts were continued. In research on the transport behavior of concentrated aqueous electrolyte solutions, the diffusion coefficients of Cd^{2+} in concentrated solutions of $Ca(NO_3)$ at 50°C were determined. Progress is reported in studies on the anodic chronopotentiometry of Be electrodes in molten mixtures of BeF_2 with alkali fluorides. The irreversible thermodynamics of electromigrational depletion chronopotentiometry was also studied. An electrochemical study of mass transport in molten $LiF-BeF_2$ mixtures was made. Mean diffusion coefficients at different temperatures are given. Work is reported on the application of the quasi-lattice model in dilute reciprocal molten salt mixtures, in particular the $Ag_2SO_4-KNO_3$ system. Other research that has been reported in the literature is also included. (JGB)

CONTROLLED THERMONUCLEAR RESEARCH

8337 (AD-780359) 17 YEARS PLASMA PHYSICS IN INNSBRUCK. Bibliography, 1957–1973. Cap, F. (Innsbruck Univ. (Austria). Inst. fuer Theoretische Physik). 15 Sep 1973. 47p. (UNICP-SR-100). NTIS $5.50.

The results of 17 years (1957 to 1973) of research in magnetohydrodynamics and plasma physics are summarized and reviewed. It also covers a summary lecture held by F. Cap in Julich, Germany, Plasma Physics Institute of the Kernforschungsanlage Julich on 14 September 1973. The following topics are discussed: MHD–theory of ideal plasma; MHD–theory of a finite conductive plasma; MHD–channel flow and accelerators; MHD–waves, shocks, characteristics; MHD–instabilities; mathematical methods; Vlasov–plasmas and echoes; microinstabilities; experimental plasma physics; and space plasmas. (GRA)

8338 (TID-3557-S4) CONTROLLED FUSION AND PLASMA RESEARCH. A Literature Search. Whitson, M. O. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Nov 1974. 342p. Dep. NTIS $10.60.

Approximately 2400 references to research reports and journal articles are cited, covering work on basic plasma physics, thermonuclear devices, magnetic fields, and other topics related to controlled fusion research. A subject index is included. (auth)

8339 TECHNOLOGY INDEX FOR PLASMA PHYSICS RESEARCH AND FUSION REACTORS. Volume 8, No. 9, 1974. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 47p.

Plasma Confinement and Heating

Refer also to abstracts 8402 and 8429.

8340 (AD-779042) LASER HEATING IN A DENSE PLASMA FOCUS. Mawardi, O. K. (Case Western Reserve Univ., Cleveland, Ohio (USA)). 31 Mar 1974. 10p. (AFOSR-TR-74-0716). NTIS $3.00.

The report is divided in two parts. In the first part an account is given of the measurement of the momentum distribution of the deuterons ejected from a dense plasma focus. The results show the existence of a pronounced non-Maxwellian distribution and a small population of deuterons accelerated to the voltage of the condenser bank. In the second part theoretical calculation of laser heating establish the presence of large density gradient which probably accounts for the large currents detected in such plasmas. (auth)

8341 (CONF-741105-3) THERMAL ISOLATION AND CONFINEMENT OF PLASMA IN THE "URAGAN" ("HURRICANE") STELLARATOR. Dikiy, A. G.; Kuznetsov, Yu. K.; Pavlichenko, O. S.; Pashnev, V. K.; Perepelkin, N. F.; Suprunenko, V. A.; Tolok, V. T. (AN Ukrainskoj SSR, Kharkov. Fiziko-Teknicheskij Inst.). Dec 1974. Translation of CN-33/B3-1. 30p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The current and high-frequency methods for heating plasma were investigated in experiments conducted on the U-1 stellarator. In both instances plasmas were obtained with parameters close to the limits for the given apparatus. With the plasma density $n = (1 \text{ to } 8) \times 10^{12}$ cm^{-3} the electron temperature in the case of current heating reached $T_e \lesssim 400$ eV (ion temperature $T_i \lesssim 30$ eV), and the ion temperature reached $T_i \lesssim 500$ eV (electron temperature $T_e \lesssim 50$ eV) using high-frequency techniques. In both cases the maximum value of the parameter $\beta = (8\pi \cdot nT/H_0^2)$ was $\simeq 10^{-3}$, and the experimental conditions basically corresponded to the "plateau" regime in terms of the neoclassical theory. Equilibrium of the plasma column, its stability (over a broad frequency range), and the behavior of the coefficients of thermal conductivity and diffusion were investigated. (auth)

8342 (CONF-741105-4) CONFINEMENT OF PLASMA WITH LOW COLLISION FREQUENCY IN STELLARATORS WITH SHEAR. Voytsenya, V. S.; Voloshko, A. Yu.; Solodovchenko, S. I.; Suprunenko, V. A.; Tolok, V. T.; Shtan, A. F. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). Dec 1974. Translation of CN-33/B3-2. 19p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

This is a survey of experimental research in the confinement of low-density plasma in stellarators, when diffusion is contributed to greatly by particles blocked in the helical inhomogeneities of the magnetic field (frequency range $\nu_e < \nu_{e2}$, where $\nu_e = \nu_{ee} + \nu_{ei} + \nu_{en}$, and ν_{e2} is the lower boundary of the plateau on the dependence of the diffusion coefficient on collision frequency). Only those results obtained in stellarators with a relatively large shear value are examined. A comparison of the experimental data with the existing theories of diffusion in systems with helical symmetry are presented. It is shown that in all cases the measured dependences of diffusion coefficients on collision frequencies are weaker than the neoclassical theory predicts; if these dependences are given in the form $D_{\perp \text{exp}} \sim \nu_e^{-\gamma}$, then for all the devices investigated, i.e., Proto-Cleo, Saturn, Vint-20 (Helix-20), Spac-1, and Heliotron D the value of γ proves to be less than unity. An empirical correlation was found between the value of γ and the parameters of the boundary magnetic surface of the apparatus. On the basis of an analysis of the data concerning plasma confinement in the saturn stellarator, it was concluded that in this device (where $\gamma \approx 0.1$) in the region of low collision frequencies, at least up to $0.1\ \nu_{e2}$, the plateau-characteristic dependence of the reduced plasma lifetime on the rotational transform angle and the magnetic field is observed: $(\tau/r_0^2) \sim t_0 \cdot H_0^2$ (τ is measured confinement time; t_0 and r_0 are the angle and radius of the outer magnetic surface; H_0 is the intensity of the confining magnetic field). Possible explanations for the differences between the theory and analyzed experiments are discussed. (auth)

8343 (CONF-741105-5) HEATING OF A PLASMA BY A POWERFUL RELATIVISTIC ELECTRON BEAM IN A STRONG MAGNETIC FIELD. Arzhannikov, A. V.; Brayzman, B. N.; Vyacheslavov, L. N.; Koydan, V. S.; Konyukhov, V. V.; Ryutov, D. D. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Dec 1974. Translation of CN-33/C2-4. 23p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The results of an experimental investigation into the interaction of a powerful relativistic electron beam with plasma in the INAP apparatus are presented. The relativistic electron beam had initial energy of 1 MeV, maximum injection current of 10 kA, duration of 70 nsec, and a diameter of 2 cm. Total beam energy at entry into the plasma was approximately 300 J. The beam was injected into the column of a hydrogen plasma 230 cm long, 8 cm in diameter, and with density of 3×10^{14} cm^{-3}. The magnetic field had mirror-trap geometry (mirror ratio 1.7, intensity in the uniform portion up to 15 kOe). In the experiments diverse diagnostic methods were used, making it possible to measure beam current, the total current within the plasma, the total energy of the beam entering and leaving the plasma, and the distribution of beam current over the cross-section at the plasma outlet; opposing high-energy electrons were recorded. The density of the preliminary plasma was controlled during the experiment; the energy content of the plasma was determined from diamagnetic measurements; the electron distribution function was analyzed by the method of Thomson scattering of light at 90°. From an analysis of the shape of the diamagnetic signals and distribution of diamagnetism along the length of the apparatus it was established that under the assumption of predominant electron heating, the temperature of plasma electrons in order of magnitude equals 1 keV for a plasma density of 5×10^{13} cm^{-3}. The cause of heating cannot be dissipation of the reversed current. According to Thomson scattering of laser radiation we established the presence of a comparatively cold plasma component with temperature of 25 eV. High-energy electrons moving from the opposite direction toward the beam were recorded; their appearance evidently was associated with acceleration of plasma electrons in the induction fields. Mechanisms which can provide effective heating of the whole mass of electrons under conditions in which paired collisions are minor are indicated. (auth)

8344 (CONF-741105-6) PRODUCTION OF A HOT ION PLASMA ON THE LOWER HYBRID RESONANCE AND MEASUREMENT OF ITS PARAMETERS. Glagolev, V. M.; Dyubaylov, A. G.; Krivov, N. A.; Martynenko, V. V.; Skosyrev, Yu. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Dec 1974. Translation of CN-33/C-5. 20p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Electromagnetic fields delayed along a magnetic field were created within a plasma with the aid of a loop encircling the plasma column. When these waves propagated transversely in relation to the magnetic field within a plasma with density rising along its radius they were delayed in the direction of propagation. The amplitude and phase distribution of the electromagnetic fields along the radius of the plasma column was measured at different moments in time. The existence of an absorption band of these waves within the plasma was detected. The absorption band was shifted toward the outer boundary from the plasma when plasma density was increased. By four independent methods it was established that the gas-kinetic pressure of the plasma, measured according to its diamagnetism, is determined by the ion component. It was found that the energy of ions at right angles to the magnetic field is considerably less than the ionic (energy). The cause of limited heating was an increase in density and energy losses in the charge-exchange process. In order to improve vacuum conditions, the loop encircling the plasma was placed in a metallic chamber, and the ultrahigh-frequency plasma source used in the original experiments was replaced by a film-hydride source. This made it possible to increase the internal energy of the plasma to 3×10^{15} $eV \cdot cm^{-3}$ at a density of $(1 \text{ to } 3) \times 10^{12}$ cm^{-3}. The mean energy of atoms leaving the plasma at right angles to the magnetic field as a result of charge exchange reached 1 keV. The region of change in plasma parameters (density and magnetic field) for which heating was observed corresponded to the linear transformation theory. Nonlinear effects could occur only in the first stage of heating, when the electric fields were strong, but plasma temperature was low. Heating efficiency was measured by a reflectometer installed in the coaxial line connecting the generator and HF input coil to the plasma. The measurements showed that ≈20% of the power generated is consumed in heating the plasma. (auth)

8345 (CONF-741105-7) PLASMA CONFINEMENT IN A PR-7 TRAP. Gott, Yu. V.; Ioffe, M. S.; Kanaev, B. I.; Motlich, A. G.; Pastukhov, V. P.; Sobolev, R. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Dec 1974. Translation of CN-33/D-3. 20p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The PR-7 is a mirror trap with minimum B created by a quadrupole system of stabilizing conductors. Plasma is injected by an intensive plasma—beam discharge. The range of parameters of the studied plasma is as follows: initial density $n_0 = (2 \text{ to } 3) \times 10^{12}$ cm^{-3}, mean ionic energy $\overline{W}_i \approx 400$ eV, and electron temperature $T_e = 7$ to 10 eV; the magnetic field in the center of the trap $B_0 = 5.0$ kOe, longitudinal mirror ratio 2.0, and transverse depth of magnetic well up to 30%. The work is directed primarily at elucidation of the reasons for the sharp increase in plasma losses which develops within a certain period following the end of injection within a decaying plasma. This effect was detected earlier in the PR-6 apparatus, and subsequently in the PR-8. One of the main problems considered is why the high-loss stage is delayed relative to the moment injection is stopped for a period of time that is definite and easily reproducible in different experiments. (auth)

8346 (CONF-741105-8) PLASMA CONFINEMENT IN THE OGRA-3 SIMPLE MIRROR TRAP IN THE PRESENCE OF A MULTI-ELEMENT FEEDBACK SYSTEM. Zhil'tsov, V. A.; Likhtenshteyn, V. Kh.; Panov, D. A.; Kosarev, P. M.; Chuyanov, V. A.; Shcherbakov, A. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Dec 1974. Translation of CN-33/D-4. 19p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The Ogra-3 apparatus is a simple magnetic mirror trap with a 2.1 mirror ratio and central magnetic field of up to 35 kG, specially constructed for conducting investigations into plasma stabilization with the aid of feedback circuits. Plasma is obtained within the Ogra-3 via injection into a vacuum of a beam of hydrogen atoms with energy of 20 keV and intensity greater than 50 equiv. mA. The vacuum conditions assure a lifetime of around 0.1 sec before charge exchange for the fast ions captured in the trap. Without special measures being taken, the plasma within the Ogra-3 is unstable with respect to hydromagnetic flute oscillations, which restrict plasma build-up near the instability threshold at densities of $1 \text{ to } 2 \times 10^8$ cm^{-3}. An electrostatic, 12-electrode feedback system with Fourier dimensional synthesis (analysis) was created to stabilize the flute instability; it suppresses the lower space modes of flute instability. Experiments with the 12-electrode system showed that the previously detected drop in losses at positive transfer coefficients of the feedback system is not a result of stabilization of flute instability, but rather is associated with nonlinear effects (namely, with a drop in the phase velocities of unstable waves and a reduction in their interaction with the confined fast ions). At the same time, these experiments demonstrated the existence of a region of stability for negative transfer coefficients. This region of stability was predicted theoretically, but was not observed in early experiments with stabilizing systems having a small number of stabilizing electrodes. An investigation was conducted and a comparison was made with the theory of plasma dispersion properties in the presence of a feedback system. In accordance with the theoretical predictions, three branches of flute oscillations were detected and their change under the influence of feedback was studied. (auth)

8347 (CONF-741105-9) PULSED TOROIDAL SYSTEM WITH AUTOMATED CONFINEMENT CHAMBER. Es'kov, A. G.; Zolotovskii, O. A.; Kalygin, A. G.; Kutmullaev, R. Kh.; Laukhin, Ya. N.; Malyutin, A. I.; Markin, A. I.; Proshletsov, A. P.; Semeenov, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Dec 1974. Translation of CN-33/E-5. 10p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

This work presents experimental results dealing with some urgent questions concerning toroidal systems: shaping and heating of toroidal plasma at temperatures $T \sim 10^3$ eV, dynamics of hot toroidal plasma with elongated cross section, and means of suppressing impurities. The method chosen for solving these problems has bearing on the following fundamental points: (1) pulsed shaping and heating of plasma configuration with closed magnetic fields; and (2) conveyance of the plasma toroid to an automated quasi-stationary confinement chamber. The possibility of attaining the required configuration by rapidly reconnecting opposing magnetic fields at the ends of the system has been demonstrated experimentally. Investigations were conducted in two representative modes: without an axial conductor with purely poloidal configuration of the magnetic field, and with an axial conductor for $H_\theta \neq 0$. The lifetime of the plasma formation without the toroidal field H_θ proved to be an order of magnitude greater than the value of $ŧ \sim 1/V_A$, which evidently is related to peculiarities in the behavior of the magnetic field in toroidal geometry with an elongated cross-section. The migration of plasma toroid shaped and heated in an impact chamber into a stationary confinement chamber was determined according to a series of independent measurements. (auth)

8348 (CONF-741105-11) EFFECTIVENESS OF THE "THETA-PINCH-WITH-LINER" TYPE OF THERMONUCLEAR SYSTEM. Alikhanov, S. G.; Konkashbaev, I. K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Dec 1974. Translation of CN-33/F6-2. 14p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The influence of the compressibility of the liner substance on the effectiveness of a "theta-pinch-with-liner" system is examined. Numerical calculations with respect to the dynamics of liner compression are conducted. The results of the calculations are approximated by estimation equations. (MOW)

8349 (CONF-741105-12) STELLATRON: A MAGNETIC SYSTEM FOR CONTAINMENT OF PLASMA WITH IMPROVED TOROIDAL EQUILIBRIUM. Danilkin, I. S.; Kovrizhnykh, L. M. (AN SSSR, Moscow. Fizicheskij Inst.). Dec 1974. Translation of CN-33/H1-2. 19p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Questions of the creation of a "stellatron" type of containment configuration—a stellarator magnetic trap with a noncircular, elliptical cross section of magnetic surfaces with a highly eccentric position—are discussed. Evaluations are made which show that in intermediate and hydrodynamic collision frequency regions the coefficients of diffusion and thermal conductivity in a stellatron can amount to a value on the order of a^2/b^2 of the corresponding coefficients of toroidal systems with a circular cross section (here, a is the minor and b the major semi-axis of the elliptical cross section of a toroidal configuration). Examples of possible current systems capable of providing the required magnetic field configuration are given. (auth)

8350 (GA-A-13151) DIFFUSIONS OF dc OCTOPOLE PLASMAS IN THE TRAPPED ELECTRON REGIME. Tamano, T.; Hamada, Y.; Moeller, C.; Ohkawa, T.; Prater, R. (General Atomic Co., San Diego, Calif. (USA)). 2 Sep 1974. Contract AT(04-3)-167. 17p. (CONF-741105-41). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Diffusions of collisionless plasmas were investigated in the dc Octopole. Three types of diffusions were observed in this regime. One is neoclassical diffusion which occurs in low electron temperatures ($T_e < 0.5$ eV) and low poloidal magnetic fields. Another diffusion is thermal fluctuation diffusion which takes place when the plasma dielectric constant is small, i.e., in low densities and high magnetic fields. When electrons are heated above 0.5 eV, the third diffusion mode appears. The plasma life time in this mode is proportional to a reciprocal of electron temperature and to a strength of poloidal magnetic field, but it is independent of plasma density and toroidal magnetic field. Thus, the diffusion is called "poloidal Bohm" diffusion, since the scaling is similar to the Bohm scaling except it has a strength of poloidal magnetic field instead of total magnetic field. The magnitude of the plasma life time is 500 ~ 1000 times longer than a "poloidal Bohm time". Judging from the magnitude of the diffusion coefficient, the cause of this diffusion is likely to be a weak turbulence due to the presence of trapped electrons. It is also noted that the poloidal Bohm scaling seems to fit the results of plasma confinement times of tokamaks and spherators. (auth)

8351 (KHFTI-73-20, pp 10-11) INSTALLATION FOR STUDYING TURBULENT PLASMA HEATING. Amelin, V. Z.; Ryzhov, N. M. 1973. (In Russian).

The technology of a 12-kJ linear theta pinch, designed for studying turbulent heating of a plasma, is described. The operating plasma is formed by an induction discharge in a vacuum chamber, 1500 mm long and 70 mm ID. Preliminary ionization permits operating at a pressure of 0.1 to 10 mtorr. Figures show cumulative curves which characterize the statistical lag time of the discharge equipment with anode potentials of 2, 5, and 15 kV. The mean square deviation of the statistical lag time from average values is no greater than 5 nsec, while the statistical lag time itself is no greater than 20 nsec. (INIS)

8352 (LA-UR-74-1508) HOT ELECTRON PRODUCTION, ANOMALOUS ABSORPTION, AND EFFECT OF INTENSE ELECTROMAGNETIC FIELDS ON INVERSE BREMSSTRAHLUNG ABSORPTION NEAR THE ELECTRON PLASMA FREQUENCY. Brownell, J. H.; Dreicer, H.; Ellis, R. F.; Ingraham, J. C. (Los Alamos Scientific Lab., N. Mex (USA)). 1974. 8p. (CONF-741105-36). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Measurements are presented of anomalously large microwave absorption near the electron plasma frequency ω_p by a completely ionized plasma. The threshold electric field required for the onset of anomalous absorption was measured over a range of density that is large enough to clearly separate the effects of Landau- and collisional-damping. Good agreement was demonstrated between these measurements and the threshold values predicted by computer solution of the exact dispersion relation for AC parametric instabilities. Energy distribution measurements are presented for the hot nonthermal electron tail produced by such anomalous absorption. The nature of these distributions depends strongly upon $(\omega_p/\omega)^2$ and microwave power. In some cases a large fraction of the anomalously absorbed power goes into less than 1% of the electrons and a bump develops on the hot tail. Below the threshold for anomalous absorption the classical electron-ion collision rate, ν_{ei}, was deduced from a measurement of the inverse bremsstrahlung absorption rate. Evidence is reported that intense electromagnetic fields modify ν_{ei}. The observations yield a simple empirical relation that applies for AC drift speeds as large as $eE/(m\omega) \approx (kT_e/m)^{1/2}$. Ohmic heating is minimized in these experiments by use of very short microwave pulses. (auth)

8353 (MATT-Q-31, pp 1-48) TOROIDAL CONFINEMENT EXPERIMENTS. Aug 1974.

In annual report covering the period January 1—December 31, 1973.

The FM-1 device permitted the detailed study of anomalous transport in plasma regimes relevant to those of present and future tokamaks. Direct measurements were made of electron thermal conductivity, by observation of the diffusion of local heat pulses across magnetic fields. Detailed evidence was obtained for the existence of the trapped-electron mode. The ST tokamak has made extensive studies of impurity injection and impurity ion transport in the plasma. On the ATC device, neutral-beam injection (6A, 14keV) was shown to function in accordance with theoretical expectations, and to raise the ion temperature appreciably (50 to 100 eV). The slowing-down rates of the injected particles were measured and compared with classical theory; the predicted effect of the tokamak toroidal electric field was verified. (MOW)

8354 (MATT-Q-31, pp 55-68) SMALL MACHINE EXPERIMENTS. Aug 1974.

In annual report covering the period January 1—December 31, 1973.

A new facility for the investigation of the heating and confinement of a CO_2-laser-produced plasma in a very strong pulsed magnetic field is described. Another linear device is H-1, capable of maintaining a 15 kG steady-state magnetic field, and used for medium-power rf heating studies. L-3 and L-4 are two hot-electron-plasma machines used for nonlinear wave studies, and Q-1 is an alkali-metal plasma device especially suited for studies of plasma properties in a quiet background plasma. (auth)

8355 (TID-26657) VELOCITY SPACE INSTABILITIES FOR ION BEAMS TRAVERSING PLASMAS. Gaffey, J. D. Jr. (California Univ., San Diego (USA)). 1973. 40p. Dep. NTIS $5.00. Thesis.

Fast ion beam injection appears to be a good method for plasma heating. For times short compared to the Spitzer term τ_s, the beam distribution function is sharply peaked in both energy and pitch angle and is, therefore, unstable to electromagnetic and electrostatic waves. The ordinary mode can be kept stable by requiring the beam velocity v_b and the plasma parameter β_{o_i} be sufficiently small. The lower-hybrid two-stream mode can be kept stable by injecting parallel enough to the magnetic axis that $\sin \theta_b < (1/4) (\sqrt{T_i/T_e})$. The ion-acoustic mode can be kept stable by keeping the beam density $n_{b_i} < \sqrt{2} (\sqrt{T_i/T_e}) (v_{th_{b_i}}/v_{th_i})$. For times greater than τ_s, the beam slows down and spreads out in velocity space. The ordinary mode is stable for the beam distribution. The increase in the beam thermal velocity $v_{th_{b_i}}$ greatly increases the threshold values of beam density for the lower-hybrid two-stream and ion-acoustic modes because $(n_{b_i}/n_{o_i}) \propto [(v_{th_{b_i}}/v_{th_i})]^3$. Again, the lower-hybrid two-stream mode is stable if $\sin \theta_b < (1/4) (\sqrt{T_i/T_e})$. (auth)

8356 CONTROL OF DENSITY CORRELATIONS IN LASER—HEATED PLASMA. Steiger, A.D.; Woods, C.H. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 17: No. 9, 1749-1756 (Sept 1974).

The excitation of plasma density perturbations of selected wavenumber spectra by two oppositely directed short-wavelength laser beams and the simultaneous interaction with these perturbations of a long-wavelength laser beam whose frequency is comparable to the electron Langmuir frequency is analyzed. Perturbations of the plasma density having a spatial period equal to one—half the wavelength of the short-wavelength beams are produced at zero frequency, and at the ion—acoustic frequency. The third beam excites the oscillating two—stream instability and the ion—acoustic decay instability, so that these initial perturbations will grow rapidly and dominate the density fluctuation spectrum. The present scheme may be useful in avoiding superthermal electrons that are typically produced when radiation from a single beam is absorbed and long-wavelength density fluctuations become significant. (auth)

8357 COMMENTS ON "EXPERIMENTAL STUDIES OF ELECTROSTATIC FLUCTUATIONS IN A TURBULENTLY HEATED PLASMA." D'Angelo, N. (Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark); Pécseli, H.L.; Petersen, P.I. Phys. Fluids 17: No. 9, 1789-1789 (Sept 1974).

Measurements of spectra of potential fluctuations in a toroid of discharge using double electrostatic probes are questioned. Various procedures are examined. (AIP)

8358 REPLY TO COMMENTS BY N. D'ANGELO, H. L. PÉCSELI, AND P. I. PETERSEN. Hamberger, S.M.; Jancarik, J. (Culham Laboratory, United Kingdom Atomic Energy Authority, Abingdon, Berkshire, United Kingdom). Phys. Fluids 17: No. 9, 1790-1790 (Sept 1974).

A reply to criticisims of previous measurements of spectra of potential fluctuations in a toroidal discharge using double electrostatic probes is presented. (AIP)

8359 ENERGY INPUT INTO A GAS ENCLOSED Z—PINCH. Manheimer, W.M., Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 17: No. 9, 1767-1770 (Sept 1974).

In a gas—enclosed Z—pinch experiment, energy is coupled from an external circuit by rapid buildup of a confining field. From the basic energetics, one can calculate the necessary current rise times for maintenance of equilibrium as a thermonuclear pinch is being formed. If the rise time is too slow, the Ohmic heating of the plasma will be fast compared with the buildup of the confining field, and it will blow out; if too fast, the confining field will build up before the plasma can heat appreciably. In the early phase of heating, very short rise times are needed (nanoseconds) so that the initial tendency of the plasma is to blow outward. (auth)

8360 STIMULATED COMPTON SCATTERING AND SELF—FOCUSING IN THE OUTER REGIONS OF A LASER—FUSION PLASMA. Ott, E.; Manheimer, W.M.; Klein, H.H. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 17: No. 9, 1757-1761 (Sept 1974).

The collective processes which can occur in the outer regions of a laser—fusion plasma are investigated theoretically and with numerical simulations. The most important processes are induced Compton scatter and self–focusing. Compton scatter can rapidly heat the plasma electrons. The self–focus instability filaments the laser light. (auth)

8361 NONLINEAR STATISTICAL THEORY OF A CONDENSATE OF PLASMONS. II. STOCHASTIC HEATING OF PLASMA IONS BY LARGE–SCALE LANGMUIR TURBULENCE. Khakimov, F.K. (V. I. Lenin Tadzhik State University, Dushanbe). Sov. Phys.–Tech. Phys. 19: No. 3, 315-318 (Sept 1974).

The heating of ions due to low–frequency waves generated by a Langmuir turbulence is evaluated. The calculations are carried out under the assumption that the ion motion is one–dimensional (the ions are "magnetized"). (auth)

8362 MAGNETIC FIELD IN A θ PINCH WITH AN AXIAL CONDUCTOR. Volkov, Y.F.; Dyatlov, V.G.; Mitina, N.I. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 19: No. 3, 323-325 (Sept 1974).

For the presence near the axis of a θ pinch of a magnetic flux, of an inverse external flux, magnetic lines of force near the axis of an azimuthal plasma current form a system of closed concentric lines. With the application of an azimuthal magnetic field the lines of force form toroidal magnetic surfaces whose major axis is the axis of the θ–pinch system. The aim of the present work is to experimentally investigate the principal parameters formed in the discharge of closed magnetic configurations. The basic investigation method is probe magnetic measurements. Using the Maxwell equation $\mathrm{curl}\ H = (4\pi/c)j$, we obtain the topography of the azimuthal plasma current. To analyze the structure of the magnetic field we numerically integrate the equation of magnetic lines of force $dr/B_r = dz/B_z = r d\varphi/B_\varphi$, where Br, Bz, and B_φ are the magnetic–field components, the z axis is the axis of the θ–pinch system. In a θ–pinch system with an applied azimuthal field there exist Tokamak–type toroidal magnetic configurations. The magnetic–surface cross sections are extended along the axis of the system. The characteristic dimensions of the cross sections are of the order of the major radius of the surfaces. This facilitates obtaining a sufficient margin of stability, which in the experiment is $q \approx 6$. The system has mean minimum B of the order of several tens of percent and shear of about $S \approx 0.4$. The time of existence of the given configuration is determined by the period of the discharge ($T = 30 = 30\ \mu$sec) and is about 7 μsec. (auth)

8363 LASER AND CONTROLLED THERMONUCLEAR FUSION. Basov, N.; Krokhin, O. Veda Tech. SSSR; 1: No. 3, 27-28(Jun 1974). (In Czech).

Plasma heating by laser radiation is briefly mentioned. (Nuclear Sci. Abstr. Czeck.)

Plasma Diagnostics

8364 (AD-779493) PROBE MEASUREMENTS IN A CONTROLLED LABORATORY ENVIRONMENT. Bishop, R. H.; Pound, E. F. (Utah State Univ., Logan (USA)). 22 Aug 1973. Contract F19628-72-C-0255. 57p. (AFCRL-TR-73-0564). NTIS $3.75.

Rf impedance probes have been used for many years as a means of measuring the electron density in the ionosphere. Although existing theories used to calculate these electron density profiles are apparently reasonably good, no thorough check had ever been made in a controlled laboratory environment. For this reason it was decided to conduct a series of measurements in a controlled laboratory plasma to substantiate the accuracy of rf impedance probe theory and to determine the problems associated with this type of study. The plasma tank of the Office National d'Etudes et de Recherches Aerospatiales (ONERA) Paris, France, was chosen as the best available chamber in which to conduct such a program. The results of this study and recommendations for future studies are presented. (auth)

8365 (AD-779757) TWO SYSTEMS FOR MEASUREMENT OF HIGH-INTENSITY VACUUM ULTRAVIOLET PLASMA RADIATION. Final Report, July 1972–January 1974. Johnson, D. J. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). May 1974. 38p. (AFWL-TR-74-43). NTIS $3.25.

An x-ray diode for measurement of vacuum ultraviolet (uv) plasma emission on a nanosecond time basis is described. Response curves for the diode are obtained via a first-order photoelectric emission model. A windowless ionization chamber system is presented which is designed for use as a vacuum uv calorimeter. The response curves for this system are also obtained via a first order theoretical model. (auth)

8366 (AD-780846) EFFECT OF THERMAL BOUNDARY LAYER ON RF MEASUREMENT OF PLASMA PARAMETERS. Singer, A.; Minkowski, J. M. (Harry Diamond Labs., Washington, D. C. (USA)). Jan 1974. 14p. (HDL-TR-1658). NTIS $4.00.

A fundamental limitation in microwave measurement of plasma parameters is established, i.e., it is shown that it is not possible to determine experimentally such plasma parameters as electron temperature, electron density, or collision frequency by means of a microwave system operating at a frequency well below the plasma frequency because the plasma boundary layer exerts a prominent effect on the measurements. A numerical example is given, using published results for argon. (auth)

8367 (LGI/R/PLAD-73.5/E) DETERMINATION OF THE EXCITATION COEFFICIENT OF THE HYDROGENIC ION FOR SPECTROSCOPIC MEASUREMENTS ON A DISCHARGE OF THE "PLASMA FOCUS" TYPE. Gratreau, P. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Gas Ionizzati). Sep 1973. 11p. Dep. NTIS (US Sales Only) $4.00.

After a condensed review of the general results relative to the ionization and excitation cross-sections, the results of the Coulomb–Born approximation are exploited (with a similar method as that which was used for the ionization coefficient) to determine a relatively precise expression—in the considered temperature interval—of the total excitation coefficient of the hydrogenic ion which applies in particular, and with more accuracy, to the H type ion. (auth)

8368 ELECTRON TEMPERATURE AND DENSITY MEASUREMENTS BY LASER SCATTERING IN TURBULENTLY HEATED PLASMA. DeSilva, A.W.; Fujita, J.; Kawabe, T.; Kondo, K.; Uyama, T. (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). Phys. Fluids 17: No. 9, 1780-1781 (Sept 1974).

Electron temperature and density have been measured by Thomson scattering prior to onset of turbulence in a linear turbulent heating experiment. Heating is faster on the outer boundary than in the column center and appears to be classical until the time when resistivity suddenly rises. (auth)

8369 INVESTIGATION OF SPATIAL DISTRIBUTIONS IN A LASER–PRODUCED PLASMA BY $H\alpha$ ABSORPTION. Ostrovskaya, G.V.; Pobedonostseva, N.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR). Sov. Phys.–Tech. Phys. 19: No. 3, 424-426 (Sept 1974).

The spatial distribution in a laser–produced plasma is studied in order to determine the feasibility of measuring plasma parameters by the absorption method. The development of a gasdynamic model is considered. (AIP)

8370 BASIC LIMITATION IN MICROWAVE MEASUREMENT OF PLASMA TEMPERATURE. Singer, A.; Minkowski, J. M. (Johns Hopkins Univ., Baltimore). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 12: No. 9, 1286-1288(Sep 1974).

A basic limitation in microwave measurement of plasma temperature was established: it was shown that it is not possible to determine the electron temperature of shock-heated plasma by means of a microwave system operating at a frequency well below the plasma frequency because the plasma boundary layer exerts a prominent effect on the microwave measurements. The limitation applies, of course, to the determination of other plasma parameters as well, such as electron density and collision frequency. This limitation is responsible, in part, for the wide discrepancies between theory and experiment obtained by means of microwave horns for shock-heated argon at relatively high Mach numbers. (auth)

Plasma Kinetics (General)

Refer also to abstract 9309.

8371 (AD-779736) MAGNETIC FIELD ANNIHILATION OF IMPULSIVE CURRENT SHEETS. Interim Scientific Progress Report. Dailey, C. L. (TRW Systems Group, Redondo Beach, Calif. (USA)). 31 Mar 1974. 33p. (AFOSR-TR-74-0747). NTIS $3.25.

Additional results obtained during the past year on the magnetic field annihilation impulsive plasma accelerator are presented. Flat spiral coils 40 cm in diameter separated by 3.6 cm are used to produce anti-parallel radial fields in an axially symmetric field configuration. These fields exist for a few microseconds as a 5 kilojoule capacitor bank is discharged through the coils producing planar current sheets that are accelerated axially toward the midplane between the coils where they collide. Radial magnetic field embedded in the plasma diffuses through the plasma after collision and is annihilated at the midplane. The data and analysis presented here complete the investigation of the two-coil accelerator. (GRA)

8372 (DLR-FB-73-45) THEORETICAL FLOW FIELD ANALYSIS FOR THE ANNULAR HALL ACCELERATOR. Robert, K. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und

Raumfahrt e.V., Porz-Wahn (F.R. Germany). Inst. fuer Angewandte Gasdynamik). 1973. 42p. (In German).

The present investigation refers to steady, barotropic, and inviscid flows of a rarefied gas plasma through an axisymmetric annular channel with imposed axial electric field and radial magnetic induction. By means of a previously developed first-order perturbation analysis closed form solutions for the electric current density as well as the flow velocity and mass density of the plasma within the annular duct for supersonic and subsonic conditions and arbitrary values of the Hall parameter are obtained and discussed. (GE)

8373 ELECTRON TEMPERATURES AND ELECTRON CONCENTRATIONS AT LOW PRESSURE IN MICROWAVE INDUCED PLASMAS. Brassem, P.; Maessen, F. J. M. J. (Univ., Amsterdam). Spectrochim. Acta, Part B; 29: No. 7, 203-210(Jul 1974).

This investigation deals with measurements of electron temperature (T_e) and electron concentration (n_e) in monoatomic and polyatomic gas plasmas in the pressure region from 0.067 up to 2.67 mbar (0.05 to torr) in flow systems. Measurements have revealed that the T_e reaches very high values in the low pressure region (0.067 mbar). T_e and n_e decrease at increasing pressure. The electron temperature appears to be independent of the applied microwave power; on the contrary the electron concentration increases with power. (auth)

8374 PROGRESS WITH SPICA. Bobeldijk, C. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Atoomenergie Haar Toepass.; 16: No. 9, 205-208(Sep 1974). (In Dutch).

Detailed technical specifications are presented of the SPICA plasma physics facility, at the FOM-Institute's Jutphass Laboratories, and preliminary experiments are discussed. The facility is a toroidal one, with major and minor radii of 60 cm and 20 cm respectively, in which a deuterium plasma is to be heated to ~ 4×10^6K at 10^{-6} Torr. First experiments planned include laser diagnostic measurements of electron scattering and energy spectra. (auth)

8375 CONTROL OF ION-ENERGY DISTRIBUTION IN A BACK-DIFFUSION TYPE PLASMA. Kawai, Y. (Chubu Inst. of Tech., Kasugai, Japan). Mem. Chubu Inst. Technol.; 9: 33-36 (Dec 1973).

A back-diffusion type plasma in which the energy distribution of the ion beam is controlled experimentally in the temperature as well as in the beam velocity is studied. The dependence of the beam energy and the temperature of ions on the grid and anode potentials are described. (auth)

8376 STUDY OF THE NEGATIVE GLOW-FARADAY DARK SPACE OF A LARGE RADIUS, SHORT LENGTH ABNORMAL GLOW DISCHARGE WITH AND WITHOUT ANODE GLOW. Spencer, H. W. III. Auburn, AL; Auburn Univ. (1974). 189p. University Microfilms Order No. 74-23,115.

Thesis (Ph. D.).

A custom-built analog computer was used in conjunction with a Langmuir probe to determine the spatial variation of the electron number density, the plasma potential, and electron temperature in the negative glow (NG) and Faraday dark space (FDS) of an abnormal H_2 glow discharge with the anode in the FDS. Axial measurements showed the development of a reverse field when discharge parameters were varied to obtain no anode glow. When compared with theory that took into account ionization by fast electrons from the cathode dark space and losses due to recombination and diffusion, reasonable agreement was obtained. At the start of the transition from no anode glow to anode glow, a linear variation in the electron number density was found along with a zero electric field. When there was no anode glow, radial measurements showed good agreement with a theory, which assumed a uniform distribution of fast electrons from the cathode dark space. The theory and measurements disagreed when there was an anode glow. The radial electron density distribution, near the anode, was found to peak on the outer edge of the discharge when there was an anode glow. Theory predicted that it should be uniformly decreasing. (Diss. Abstr. Int., B)

8377 TIME DEPENDENT ELECTRON SCATTERING AND ENERGY TRANSFER IN A BOUNDED BEAM-PLASMA SYSTEM. Freese, K. B. Hanover, NH; Dartmouth Coll. (1974). 143p. University Microfilms Order No. 74-23,081.

Thesis (Ph. D.).

The time evolution of an initially unstable electron beam-plasma system has been observed experimentally. The unstable plasma waves which are linearly unstable in the presence of the beam, grow to a saturated amplitude, and scatter the beam particles. Under extremely turbulent conditions, the directed beam energy is converted to thermal energy of a hot electron plasma, and a high energy tail is produced. Time resolved measurements of the unstable mode amplitudes and the scattered particle density were made in a mildly unstable beam-plasma system. These observations have enabled us to refine some previously published arguments concerning the wave growth, and quenching of the unstable modes in the system. Simultaneous measurements of these quantities reveal that the high energy tail formation is not a steady state process. The production of fast particles occurs in concert with the unstable growth of low frequency, high phase velocity waves in the plasma. An existing numerical model of beam scattering due to a single mode was extended to include the case of many modes. The results of that model are compared with experiments. The fast unstable waves observed in the system have phase velocities greater than the beam speed, thus disallowing any linear excitation. The nonlinear wave-wave coupling between electron plasma waves in a bounded geometry is investigated. Both experiments and numerical calculations suggest that the degenerate parametric instability is responsible for the fast mode excitation. The numerical model is extended to the extremely turbulent regime, in an effort to explain the efficient heating of the plasma, which is observed experimentally. The shape of the distribution function produced by the model is in excellent qualitative agreement with experimental observations. However, the plasma temperature is ~20% cooler than in experiments. The high energy tail is larger than the experimental tail, and contains ~50% more particles. (Diss. Abstr. Int., B)

8378 ENERGY DISTRIBUTIONS OF MASS-SELECTED IONS FROM THE PLASMA OF A PULSED VACUUM ARC. Grissom, J. T. (Sandia Labs., Albuquerque, N. Mex. (USA)). J. Mass Spectrom. Ion Phys.; 14: No. 4, 389-400(Aug 1974).

Energy and angular distributions of mass-selected ions from the plasma of a vacuum arc of 5 to 6 μsec duration have been measured using a cylindrical electrostatic energy analyzer in tandem with a quadrupole mass filter. The arc electrodes were Kovar separated by an alumina ceramic insulator, with a thin strip of vanadium deposited over the anode and the insulator surface between the electrodes. Energy distributions have been measured for V^{+1}, V^{+2}, and V^{+3} from the vanadium film; O^{+1}, O^{+2}, Al^{+2}, and Al^{+3} from the insulator; and C^{+1} and C^{+2} from carbonaceous contaminants. The significant features of the energy distributions are the existence of a low-energy cutoff, the presence of a single peak having a characteristic energy position and width, and the presence of a high-energy component with ion energies per unit charge greater than the total arc voltage. The angular distributions indicate that no directional energy discrimination was introduced by performing the energy measurements in the forward direction. (auth)

8379 STRUCTURE OF NON-LINEAR WAVES WITH ELECTRON BUNCHING IN BUNCH-PLASMA SYSTEM. Gladkii, A. M.; Kovalenko, V. P. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 4, 690-692(Apr 1974). (In Russian).

The electron beam probe method was used to determine the time profile of waves of an electric field on a nonlinear stage of a beam-plasma interaction. It was established that this wave may not be harmonic but may have specific nonlinear structure due to a strong grouping of the electron beam. (tr-auth)

8380 EXPERIMENTAL AND THEORETICAL INVESTIGATION OF PERTURBATION PRODUCED BY A CHARGED FILAMENT IN PLASMA WITH A BEAM. Brodskii, Yu. Ya.; Mironov, V. A.; Us, V. N. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 8, 1101-1107(1974). (In Russian).

The perturbation of the structure of a charge produced by the electron beam was investigated under the conditions when the free electron path is of the order of the system sizes when a filament is inserted in the charge. It is shown that under definite conditions, the observed perturbation of the plasma glow resembles a shock wave in an ultrasonic flow and is associated with the existence of the electron beam. (auth)

Plasma Kinetics (Experimental)

8381 ELECTROSTATIC PRECESSION OF ELECTRON LAYERS PART I: LONG E LAYERS. Condit, W.C. Jr.; Lovelace, R.V. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 17: No. 9, 1719-1721 (Sept 1974).

An analysis is made of the coherent electrostatic precession of an unneutralized astron E layer. This precession is analogous to a slow E×B drift of the relativistic electrons of the E layer in the applied axial magnetic field and in the electric field arising from the image charges on the conducting vessel walls. The analysis assumes an E layer with axial length much longer than its radius, a precession frequency much smaller than the relativistic cyclotron frequency, coherent motion of the individual electrons, and small amplitude perturbations. The electrostatic precession is predicted to occur at a much higher frequency than that of the magnetic precession observed for neutralized E layers. The precessional motion is in the direction of the electron cyclotron motion and therefore is expected to be unstable to dissipative forces. (auth)

8382 FLUXES OF CHARGED AND NEUTRAL PARTICLES FROM TOKAMAKS. Hogan, J. T.; Clarke, J. F. (Oak Ridge National Lab., Tenn. (USA)). J. Nucl. Mater.; 53: 1-8(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The performance of present tokamak devices is significantly influenced by neutral atom and impurity ion populations originating at the wall or aperture limiter. Plasma instability and diffusion mechanisms cannot be identified until these surface-related processes are accurately described. Central neutral densities in the Oak Ridge tokamak vary from 2×10^8 cm^{-3} to 2×10^9 cm^{-3} and agree well with values predicted by a theoretical model. This model is extrapolated to the larger, denser and hotter plasmas foreseen in the next generation of experiments and beyond. The rate of impurity generation by charge exchange bombardment is calculated. Impurities will influence scientific feasibility experiments which burn D-T by raising ignition temperatures. In a code which incorporates alpha heating, bremsstrahlung, synchrotron and line radiation the effects of small admixtures of high Z ions on the injection power required to reach ignition and on the required pulse duration are calculated. The expected wall energy fluxes and the relative fractions of energy conduction and radiation are given. (auth)

Plasma Kinetics (Theoretical)

8383 (AD-779272) ANGULAR MOMENTUM CONSTANT OF A TWO-DIMENSIONAL GUIDING-CENTER PLASMA. Book, D. L. (Naval Research Lab., Washington, D. C. (USA)). May 1974. 10p. (NRL-MR-2804). NTIS $3.00.

A constant of the guiding-center motion of a two-dimensional plasma is displayed and applied to the statistical mechanics of negative temperature states. (auth)

8384 (AD-779722) MAGNETIC NEUTRALIZATION IN A MODULATED ELECTRON BEAM-PLASMA SYSTEM. Final Report, April–September 1973. Miller, R. B. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). May 1974. 50p. (AFWL-TR-73-278). NTIS $3.25.

The injection of an intense, relativistic electron beam into a plasma is facilitated by counterstreaming plasma electrons which tend to neutralize the self-magnetic field of the electron beam. Magnetic neutralization is examined for the case of injection of a modulated electron beam into a plasma. Analytical expressions are derived and compared with the unmodulated beam case. (auth)

8385 (CONF-740471-1) TWENTY-FIVE YEARS OF PLASMA PHYSICS. Thompson, W. B. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). [nd]. 31p. Dep. NTIS $4.75.

From proceedings of quarter century; Toronto, Canada (Apr 1974).

A historical review is given of plasma physics research during the past 25 years. The following topics are reviewed: (1) basic theory and experiments on waves and oscillations, (2) magnetohydrodynamics, (3) low frequency behavior of plasma quasi-MHD, (4) plasma stability, (5) plasma turbulence, (6) basic kinetic theory, and (7) plasma confinement. (MOW)

8386 (EUR-5127e) LECTURES IN PLASMA PHYSICS: THE MAGNETOHYDRODYNAMIC APPROACH TO THE PROBLEM OF PLASMA CONFINEMENT IN CLOSED MAGNETIC CONFIGURATIONS. Mercier, C.; Luc, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Sep 1974. 157p. Dep. NTIS (US Sales Only) $11.00. EUR B. Fr. 500.-.

The general properties relating to the equilibrium of a plasma with scalar pressure in a toroidal magnetic configuration are discussed. The MHD approach to plasma stability in magnetic traps was studied. The energy principle of Bernstein et al., is discussed and accent is placed on a very general necessary criterion, which, although not sufficient, is yet very stringent and which has the advantage of making evident the effect of the principal characteristics of the equilibria with regard to the stability, namely the "mean magnetic well," the "shear" and the effect of the pressure. A review is given of some methods for solving the MHD equations. All these methods rely on the introduction of a particular set of coordinates: the so-called intrinsic coordinates. (MOW)

8387 (JAERI-M-5697) NUMERICAL SIMULATION OF THE TOKAMAK PLASMA WITH A MOVABLE BOUNDARY. Takeda, T.; Itoh, S. (Japan Atomic Energy Research Inst., Tokyo). May 1974. 45p. NTIS (US Sales Only).

A numerical simulation of the tokamak plasma with the magnetohydrodynamic fluid model is described. The code has the following applications: interpretation of the experiment of a tokamak plasma with a dynamic limiter and comparison of the experimental with the theoretical results obtained with various transport theories. For the former application position of the boundary in the code is movable. For the latter main part of the code can be written automatically in a formula manipulation language (IBM-FORMAC). Examples of the numerical calculation are also given. (auth)

8388 (MATT-Q-31, pp 49-54) THEORY. Aug 1974.

In annual report covering the period January 1–December 31, 1973.

The report of the theoretical program has been divided into four sections: Equilibrium, Stability, and Transport (mostly tokamak-related); Plasma Heating and Parametric Instabilities; Computer Simulation-Particles and Fluids; and Theoretical Research under the Air Force Contract (basic plasma physics, space physics and astrophysics). (auth)

8389 (UCID-16157) DEFLECTION OF FAST IONS IN A PLASMA. Cooper, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1970. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

The problem of the simultaneous slowing and deflection of ions of the type resulting from fusion reactions is discussed. It is shown that most of the energy is indeed deposited as the ions are traversing straight line trajectories. However, one finds that if this type of path is continued until energy equilibration is attained, a significantly longer path length results. To correct for this, a simple model is presented which gives a prescription for determining when the ions become isotropic. The model assumes a straight line path until the deflection and energy loss times are equal. Then an abrupt change to isotropy is made. Consideration of the fairly strong energy dependence of the deflection time prompts the assumption of an instantaneous switch. This type of treatment can be readily assimulated into calculations which presently assume straight line trajectories. A further study of the deflection problem is made by numerical and approximate analytic solutions of the Fokker–Planck equation for Coulomb collisions. These results give a more detailed description of the angular distribution of the ions during the entire thermalization process. It is found that the assumptions of the simple model are satisfied quite well. (MOW)

8390 (UCID-16623) LIMIT OF NONADIABATIC ENERGY IN 2XIIB. Nexsen, W. E. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Nov 1974. Contract W-7405-eng-48. 12p. Dep. NTIS $4.00.

Limits for adiabatic behavior in the 2XIIB magnet were studied. Numerical calculations were made to test an analytic expression for the adiabatic limit. The presence of finite-β plasma was found to reduce the limit to where nonadiabatic losses may be significant in 2XIIB. (auth)

8391 (UCID-16638) OVERVIEW OF SPECTRAL-LINE PROFILES EXPECTED FROM IONS IN PLASMA. Shore, B. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1974. Contract W-7405-Eng-48. 30p. Dep. NTIS $4.50.

The mechanisms which broaden spectral lines in plasmas are summarized and the magnitudes of relevant parameters for Lyman-α-like lines of hydrogenic-ion impurities in a plasma are discussed. A bibliography on recent relevant theoretical work on line profiles is included. (auth)

8392 THEORY OF NONNEUTRAL PLASMAS. Davidson, R. C. Frontiers in Physics, Number 43. Reading, PA; Addison-Wesley/W. A. Benjamin, Inc. (1974). 112p. $15.00.

This book is an introduction to the equilibrium and stability theory of magnetically confined nonneutral plasmas. Atomic processes and discrete particle interactions are omitted from the analysis, and collective processes are assumed to dominate on the time and length scales of interest. Two levels of theoretical description are available for a collisionless nonneutral plasma. These are (1) a microscopic or kinetic description based on the Vlasov-Maxwell equations which includes finite-temperature effects in a natural manner, and (2) a macroscopic fluid description based on the moment-Maxwell equations. The basic equations and range of validity of the kinetic and macroscopic descriptions are summarized. The macroscopic equilibrium and stability properties of cold nonneutral plasmas in uniform magnetic field geometries are described. The equilibrium and stability properties of magnetically confined nonneutral plasmas are examined within the framework of the Vlasov-Maxwell equations. Configurations ranging from toroidal ring currents of relativistic electrons to intense relativistic electron beams in linear-beam geometries are analyzed. (MOW)

8393 IMPURITY TRANSPORT IN THE PFIRSCH–SCHLÜTER REGIME. Rutherford, P.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 17: No. 9, 1782-1784 (Sept 1974).

It is shown that the classical inward diffusion of high–Z impurities in toroidal plasmas is enhanced by the Pfirsch–Schlüter effect. Numerical transport coefficients are evaluated. Typically, both density and temperature gradients are found to produce inward impurity diffusion. (auth)

8394 STABILITY OF FIELD–EMISSION BEAMS IN NANOSECOND DISCHARGES. Babich, L.P. Sov. Phys.–Tech. Phys. 19: No. 3, 371-372 (Sept 1974).

The stability of the field–emission beams in a plasma is analyzed in the collisionless approximation. It is assumed that turbulence of the plasma can occur near the cathode in nanosecond vacuum and gas discharges; it is also assumed that a group of stochastically accelerated electrons, having an energy exceeding the applied voltage, can be produced. (auth)

8395 ZAKLDY KLASICKE A KVANTOVE FYZIKY PLAZMATU. (Fundamentals of Classical and Quantum Plasma Physics). Kracik, J.; Sestak, B.; Aubrecht, L. Prague; Academia (1974). 317p.

An attempt is made to give a simplified and yet well rounded account of the theoretical concepts of plasma physics, giving special attention to the present state of the field of quantum plasma physics. Following a review of the statistical mechanics of colliding particles, including a derivation of the Boltzmann, Vlasov, and Landau equations by Bogoliubov's method, a study is made of mutual interactions between particle, discussing in some details the concepts of Coulomb scattering and Debye screening. Attention is focused on the derivation of the Boltzmann integrodifferential equation and on the Hilbert and Chapman-Enskog methods of solving this equation. Also discussed is the expansion of the Boltzmann equation in a spherical harmonic series and in tensor form. The use of the Fokker-Planck equation in studying Coulomb interactions is considered, including a detailed treatment of so-called Rosenbluth potentials. Finally, the fundamentals of quantum statistical physics and the application of quantum kinetic equations are reviewed. (IAA)

8396 BOLTZMANN EQUATION FOR THE ELECTRON GAS OF A NONDEGENERATE PLASMA. Gould, R. J. (Univ. of California, San Diego, La Jolla). Ann. Phys. (N.Y.); 84: No. 1-2, 480-504(15 May 1974).

The collision terms in the Boltzmann equation associated with various processes are derived. For processes having a Fokker–Planck (F-P) limit, the associated F-P operator is derived by means of physical arguments to determine the form of the operator; its multiplying constant is fixed by calculating the total energy exchange rate and comparing with the rate computed by other means. In this manner, the F-P operator is derived for electron-ion scattering, electron-electron scattering in the high-velocity limit, electron-atom elastic scattering, Compton scattering, and the high-velocity limit for inelastic scattering. Other processes considered are bremsstrahlung, radiative-recombination, photoionization, collisional ionization of atoms, and suprathermal-particle ionization of atoms. (auth)

8397 TRANSPORT PROPERTIES OF DENSE PLASMA. Kalitkin, N. N.; Kuz'mina, L. V.; Rogov, V. S. Chislennye Metody Mekh. Sploshnoi Sredy; 4: No. 4, 88-92(1974). (In Russian).

The Boltzmann equations are solved in the Chapman–Enskog approximation. It is reported that on the basis of the described methods, programs were compiled and calculations were conducted on a computer. The results of the calculation were detailed tables of the degree of ionization, pressure, internal energy, electric conductivity, and electron heat conduction of a plasma of the following elements and mixtures: lithium, potassium, cesium, aluminum, copper, hydrogen, carbon, nitrogen, oxygen, argon, xenon, air, carbon dioxide and textolite. In these tables the temperature was changed from 5000° to 300,000°, and the concentration of heavy particles was changed from 3×10^{16} to 3×10^{20} cm^{-3}. (Referativnyi Zh.)

8398 SELF-SIMILAR BEHAVIOR OF PLASMA FLUID EQUATIONS. Hsuan, H. C. S.; Lonngren, K. E.; Ames, W. F. (Iowa Univ., Iowa City (USA)). J. Eng. Math.; 8: No. 4, 303-309(Oct 1974).

Using the "s-parameter groups of transformations" technique the self-similar behavior for three sets of commonly used plasma fluid model equations is ascertained. The self-similar variables are $\xi = x/t^A$, $\xi = t/x^B$ or $\xi = t \exp(-\alpha x)$ where A, B and α are numbers and x and t are space and time variables. The resulting ordinary differential equations are obtained. By judicious choices of the parameters, a partial integration of the equations is obtained, thus displaying the analytic character of the systems. (auth)

8399 ANALYSIS OF TOKAMAK-PLASMA STEADY STATE BY NONLINEAR PROGRAMMING. Toi, K.; Takeda, T. (Japan Atomic Energy Research Inst., Tokai). Nucl. Fusion; 14: No. 4, 577-579(Sep 1974).

To demonstrate the applicability of non-linear programming to the analysis of tokamak equilibria, the differential equation governing the thermal equilibrium of an ion component of the tokamak plasma is solved by the non-linear programming after converting it to the variational problem. The simplified neoclassical thermal transport equation adopted by Artsimovich for a deduction of the scaling law of the ion temperature is solved for the given profiles of electron density ($n_e(r)$) and plasma current density ($j_z(r)$) over the cylindrical plasma cross-section, and the proportional constants $\lambda = (T_i(0)/[(IH_zR^2n_e(\mathrm{rad}))^{1/3}/A_i^{1/2}])$ are evaluated, where $T_i(0)$, I, H_z, R, n_e(rad) and A_i are the ion temperature ($T_i(r)$) on a plasma axis, the plasma current, the toroidal magnetic field, the major radius of the plasma, the electron density averaged over the plasma radius and the atomic weight of the ion, respectively. (MOW)

Plasma Production

Refer also to abstracts 8360 and 8369.

8400 (AD-778992) STIMULATED COMPTON SCATTERING SELF-FOCUSING IN THE OUTER REGIONS OF A LASER-FUSION PLASMA. Ott, E.; Manheimer, W. M.; Klein, H. H. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 22p. (NRL-MR-2738). NTIS $3.00.

The collective processes which can occur in the outer regions of a laser fusion plasma are investigated theoretically and with numerical simulations. The most important processes are induced Compton scatter and self-focusing. Compton scatter heats the plasma until the electron thermal velocity is of order of the oscillating velocity in the field of the laser light. The self-focus instability filaments the laser light and modulation of the laser intensity can be as high as 50%. (auth)

8401 (AD-779067) HOT-SPOT MODEL OF K-LINE EMISSION FROM LASER-HEATED PLASMAS. Whitney, K. G.; Davis, J. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 47p. (NRL-MR-2780). NTIS $3.25.

A nonhydrodynamic model is developed to describe x-ray emission from laser-heated plasmas on a subnanosecond time scale. The model is first correlated with experiment and then is used to study the conversion efficiency of laser energy to K-line x-rays in carbon, fluorine, and aluminum plasmas as a function of incident laser intensity. It is found that these conversion efficiencies peak at well defined values of input energy per area for laser pulse widths smaller than the pumping time for K-line emission. In this case, the degree and not the rate of plasma heating is important in determining the peak conversion efficiency. It is also found that peak conversion to K-radiation in excess of roughly 10 or 20% occurs only when the C, F, and Al plasmas are optically thick to the K_α lines. (auth)

8402 (CONF-741105-10) EXPERIMENTAL INVESTIGATIONS INTO THE INTERACTION OF HIGH-POWER LASER RADIATION WITH A PLASMA IN MISHEN'-1 AND MISHEN'-2 DEVICES. Aleksandrov, V. V.; Anisimov, S. I.; Borsenko, V. L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Dec 1974. Translation of CN-33/F3-2. 19p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Numerical calculations were carried out for a one-dimensional, two-temperature hydrodynamic model. The influence of the pulse shape on the degree of compression and temperature was studied. Compression stability relative to an approximation of an "ideal pulse" was shown as piecewise-linear. An example of temperature and density distribution is shown. (Compression occurs with symmetric two-sided irradiation of a flat target. The pulse shape is shown at the top, and energy is 2 × 0.5 kJ. Distributions correspond to a moment in time of 11.65 nsec.) All variants of the numerical calculations were developed for laser pulse parameters and conditions which can be realized in the Mishen'-2 (Target-2) apparatus. (MOW)

8403 (UCID-16617) EFFECTS OF ENHANCED LASER-INDUCED STRESS WAVES IN THIN ALUMINUM SHEETS. Wilcox,

W. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1974. Contract W-7405-eng-48. 13p. Dep. NTIS $4.00.

Rear-surface spall, permanent deformation, and material failure are produced in thin sheets of aluminum using a Q-switched ruby laser and employing plasma-confinement techniques to enhance the amplitudes of laser-induced stress waves. A variety of aluminum thicknesses are tested both with and without plasma-confining tamping material on the target surface. Representative samples are examined by metallurgical sectioning and then photomicrographed to determine the effects of the high-amplitude, laser-induced stress waves. (auth)

8404 (UCID-16643) LASER-TARGET PLASMA MODEL. Futch, A. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Nov 1974. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

A mathematical model describing the trapping of an energetic neutral beam on a decaying laser-target plasma was formulated. Fokker–Planck equations for the ionized species are coupled to rate equations for the neutral gas species. The plasma radius is a variable that changes with time to maintain an equilibrium between trapping and charge-exchange losses at the plasma surface. (auth)

8405 (SAND-74-5367) ELECTRON BEAM INDUCED PELLET FUSION. Yonas, G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 18p. (CONF-740735-1). Dep. NTIS $4.00.

From 4th national school on plasma physics; Novosibirsk, USSR (29 Jul 1974).

Experiments and theory leading to the implosion of pellets using electron beams are discussed. Focusing of the beams, energy deposition, and electron-beam technology are discussed in particular. (MOW)

8406 AN EXPERIMENTAL MODEL OF MIGMACELL. I. Experimental Set-Up and Low-Current Studies of Orbit Geometry. Maglich, B.; Mazarakis, M.; Galayda, J.; Robinson, B.; Lieberman, M.; Weber, B. (Rutgers—the State Univ., New Brunswick, N. J. (USA)); Colleraine, A. P. (Florida State Univ., Tallahassee (USA)); Gore, R. (Maryland Univ., College Park (USA)); Santeller, D. (Aero-Vac Corporation, Burlington, Massachusetts, USA); Chieng, C. C. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Nucl. Instrum. Methods; 120: No. 2, 309-319(1 Sep 1974).

An experimental model of migmacell, including its beam transport, injection, orbit diagnostics and the five-stage differential vacuum system (10^{-12} torr) is described. Experimental orbit studies using a low-intensity molecular ion beam and the conditions in which a self-colliding orbit configuration ("figure-of-eight") is obtained are presented. (auth)

Plasma Stability

Refer also to abstracts 8346, 8355, and 8417.

8407 (TRITA-EPP-74-04) FLUTE STABILIZATION IN THE BOUNDARY LAYER OF AN IMPERMEABLE PLASMA. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Jan 1974. 29p. Dep. NTIS (US Sales Only) $4.50.

In a quasi-steady impermeable magnetically confined plasma, a partially ionized, dense, and cool boundary layer of finite size develops between the fully ionized plasma body and a surrounding neutral gas blanket. The dynamics of the plasma in this layer is strongly affected by the collision processes between all kinds of charged and neutral particles. For wave and instability modes of moderately high frequencies there is a strong plasma-neutral gas coupling, leading to an equivalent plasma viscosity. A simple localized analysis indicates that flute type perturbations should become completely stabilized by a joint viscosity-resistivity-pressure effect. If this result turns out to become applicable to full-scale fusion reactors, it should provide a flexible alternative to minimum average-B stabilization in the boundary layer. (auth)

8408 TRAPPED–ELECTRON DRIFT INSTABILITY CAUSED BY BAD CURVATURE. Yoshikawa, S.; Okabayashi, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 17: No. 9, 1762-1766 (Sept 1974).

The effect of curvature on the trapped electron drift instability is considered. If the particles are trapped in bad curvature regions, the instability is seen to have a growth rate comparable to that of the temperature gradient instability treated by Kadomtsev and Pogutse. On the other hand, particles trapped in good curvature regions have a stabilizing influence, although a lower growth rate mode (which has a node at the magnetic field minimum) can still exist. (auth)

8409 NONLINEAR INSTABILITY OF A HELICON PACKET IN AN ANISOTROPIC PLASMA. Istomin, Y.N.; Karpman, V.I. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio–Wave Propagation, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Tech. Phys. 19: No. 3, 405-406 (Sept 1974).

The instability region of a nonlinear quasimonochromatic packet of helicons ("whistlers") in a plasma with a loss cone is wider than that predicted by linear theory. (auth)

8410 INFLUENCE OF LOWER-BRANCH ELECTROSTATIC OSCILLATIONS ON THE LOW-FREQUENCY INSTABILITY OF AN INHOMOGENEOUS PLASMA. Kopecky, V. (Ceskoslovenska Akademie Ved, Ustav Fyziky Plasmatu, Prague). Ukr. Fiz. Zh. (Ukr. Ed.); 19: 558-564(Apr 1974). (In Ukrainian).

The influence of a high-frequency field on the stability of a cold plasma of nonuniform density along the y axis situated in a magnetic field oriented parallel to the z axis is examined. It is assumed that electrostatic oscillations at a frequency below the electron cyclotron frequency are excited in the plasma by an electron beam, and that the excited electrostatic traveling wave is the normal mode in the direction of the y axis and is independent of the x coordinate. The analysis is limited to the stability of flute oscillations with a zero z-component of the wave vector. It is shown that the high-frequency field will generate an instability at frequencies below the ion cyclotron frequency, and that for certain plasma parameters, the field may stabilize long-wave gravitational instabilities. (IAA)

8411 INJECTION OF HIGH-CURRENT, RELATIVISTIC ELECTRON BEAMS INTO A PLASMA AND GAS. Vallis, G.; Zauer, K.; Zyunder, D.; Rosinskii, S. E.; Rukhadze, A. A.; Rukhlin, V. G. (Central Inst. of Electron Physics, Berlin). Usp. Fiz. Nauk; 113: No. 3, 435-462(Jul 1974). (In Russian).

This article reviews theoretical and experimental studies on the injection of high-current, relativistic electron beams into a plasma and neutral gas. First studies are presented on the investigation of equilibrium configurations of electron beams, partially or completely neutralized by current and charge. A determination is made of limiting beam currents attainable in various equilibrium configurations. Then problems are considered on establishing equilibrium during injection of relativistic electron beams into a plasma and neutral gas. On injection of an electron beam into a plasma, particular attention is devoted to processes of neutralizing the charge and current, and on injection of a beam into a neutral gas, a discussion is also carried out on phenomena of gas ionization, and the capture and acceleration of ions in a space charge field at the forward front of the beam. Results are presented on experimental investigations which are compared with theoretical concepts developed at present. 3 tables. 12 illustrations. 90 references. (SJR)

8412 RETURN CURRENT INSTABILITY AND ITS EFFECTS ON BEAM–PLASMA SYSTEM. Goswami, B. N.; Lakhina, G. S.; Buti, B. (Physical Research Lab. Ahmedabad, India). Pramana; 3: No. 1, 10-27(Jul 1974).

The return current induced in a plasma by a relativistic electron beam generates a new electron-ion two-stream instability (return current instability). Although the effect of these currents on the beam-plasma e-e instability is negligible, there exists a range of wave numbers which is unstable only to return current (RC) instability and not to e-e instability. The electromagnetic waves propagating along the direction of the external magnetic field, in which the plasma is immersed, are stabilized by these currents but the e.m. waves with frequencies, $\omega^2 \ll \Omega_e^2 \ll \omega_{pe}^2$ (Ω_e and ω_{pe} being cyclotron and plasma frequency for the electrons of the plasma respectively) propagating transverse to the magnetic field get destabilized. Heuristic estimates of plasma heating, due to RC instability and due to decay of ion-acoustic turbulence generated by the return current, are made. The fastest time scale on which the return current delivers energy to the plasma due to the scattering of ion-sound waves by the electrons can be $\sim \omega_{pi}^{-1}$ (ω_{pi} being the plasma frequency for the ions). (auth)

8413 FINITE BETA DRIFT CYCLOTRON INSTABILITIES IN AN INHOMOGENEOUS PLASMA. Higuchi, Y. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 52: No. 14, 1265-1273 (15 Jul 1974).

The effect of finite beta (the ratio of plasma kinetic pressure to magnetic field pressure) on drift cyclotron instabilities for the nonresonant and ion resonant modes is investigated through numerical analysis of their dispersion relations. For the nonresonant mode, it is found that the two unstable regions are merged into one unstable region, if the steep density gradient is decreased, and there is a new mode which has approximately ion cyclotron frequency due to the effect of finite beta. For ion resonant convective modes ($k_z \neq 0$), finite beta greatly reduces the instability growth rates, though it does not remove instabilities completely. Furthermore, the effects of magnetic field gradient and curvature are examined. It is found for the nonresonant mode that the maximum growth rates are slightly enhanced. For the ion resonant mode, they are slightly reduced and the wave number of the fastest growing wave is increased as the gradient and curvature drift velocity are decreased. (auth)

8414 ELECTROSTATIC ION CYCLOTRON INSTABILITY DUE TO AN ION BEAM IN A PLASMA. Ishizuka, H.; Ono, H.; Kojima, S. (Tokyo Univ. of Education). J. Phys. Soc. Jap.; 36: No. 4, 1158-1163(Apr 1974).

Experiments were carried out in which a 3 to 5 keV helium ion beam was injected into a low-density helium plasma along a pulsed magnetic field. Low-frequency waves growing in the direction of the beam flow were observed for the magnetic field strengths of 300 to 2000 G, which were characterized by the oscillation frequency in excess of the ion cyclotron frequency but less than the ion plasma frequency. The wave mode was axisymmetric and the radial wave number was much larger than the axial one. Axial wavelength measurements on launched waves suggested that the phase velocity of the growing wave was nearly equal to the ion beam velocity. Most of the experimental results were found to be consistent with a simplified theory of electrostatic ion cyclotron instability in a slow-beam plasma system, which however predicted larger growth rate than that measured. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 8518 and 8525.

8415 (AD-779070) NUMERICALLY DETERMINED GREEN'S FUNCTIONS FOR TORUS-LIKE CONFIGURATIONS. Hain, K. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 26p. (NRL-MR-2781). NTIS $3.25.

General Green's functions are derived for the current distribution on torus-like configurations. They are determined either by specifying the potential on the surface or the total surface current. For cylindrically symmetric surfaces, an integration over the angle can be performed analytically. The numerical solution of the integral equation is achieved for two- and four-coil systems, where a current is given in one coil and the potential is zero at the surface of the other coil. Numerical results are shown. (auth)

8416 (AD-781038) DESIGN AND CONSTRUCTION OF TORMAC IV, A TOROIDAL, BI-CUSP PLASMA CONTAINMENT DEVICE. Gallagher, C. C.; Levine, M. A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 6 Mar 1974. 25p. (AFCRL-PSRP-590; AFCRL-TR-74-0122). NTIS $3.00.

Tormac 4 features the production, containment, and heating of plasma within a 48 cm od toroidal chamber. The plasma has a predicted shield-shaped cross section, an included toroidal magnetic field component, and is contained by a two-pole cusp magnetic fluid comprised of both toroidal and poloidal components. The principal plasma heating is provided by an additional magnetic field component at 0.7 MHz. An electrolytic, analog tank facilitates the coil design and indicated that 18 kJ is sufficient to produce a uniform 6 kG on the plasma surface. An integral winding system for the poloidal and toroidal field coils minimizes coupling problems and simplifies insulation requirements. Single turn coils for preionization and heating are applied external to the poloidal-toroidal windings, and the whole device is reinforced with PVC plates and steel tie rods. (auth)

8417 (AD-781137) PLASMA ENGINEERING: INSTABILITIES, PARTIAL DELIVERY Nr. 1 OF THE ENGINEERS HANDBOOK ON PLASMA INSTABILITIES. (Innsbruck Univ. (Austria). Inst. fuer Theoretische Physik). Mar 1974. 38p. (AFOSR-TR-74-0717). NTIS $3.25.

The report is the first part of an engineer's handbook on plasma instabilities and their use, control, stabilization and engineering application. The book may be used for design and feasibility studies of thermonuclear fusion and other plasma engineering devices. The first delivery describes the many useful technological applications of plasma and fusion devices, as well as the aim, purpose and scope of the book. (auth)

8418 (BNL-19336) SYNOPSIS OF STUDIES ON SYNTHETIC FUELS PRODUCTION BY FUSION REACTORS. Powell, J. (Brookhaven National Lab., Upton, N. Y. (USA)). Jun 1973. 22p. Dep. NTIS $4.25.

The principal conclusions of this study are: (1) Synthetic fuels derived from fusion reactors can supply most of the U. S. energy needs, eliminating all oil and gas imports, coal gasification, and coal strip mining. Fusion reactors can supply the synthetic fuels indefinitely into the future. (2) Synthetic fuels from fusion reactors will probably be somewhat more expensive than synthetic fuels derived from coal. (3) Fusion reactors seem preferable to fission reactors for the production of synthetic fuels. (4) CTR power generation in the U. S. is almost an order of magnitude larger if CTRs are used for synthetic fuel production rather than only for electric generation. (5) CTR unit reactor size can be much larger if synthetic fuels are produced. (6) Catalyzed DD fuel cycles appear competitive with DT fuel cycles for large power ratings. (7) The large reactor ratings possible with synthetic fuel production should significantly ease plasma containment problems. (MOW)

8419 (CEA-CONF-2612) VACUUM CHAMBER OF A TOKAMAK PLASMA EXPERIMENT (TFR). Sledziewski, Z.; Huguet, M.; Rubut, P. H.; Torossian, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1974. 14p. (CONF-740353-2). Dep. NTIS (US Sales Only) $4.00.

From 6th international vacuum congress; Kyoto, Japan (25 Mar 1974).

The toroidal vacuum vessel consists of 8 corrugated bellow parts, which connect 8 observation sections. Each section has 3 large portholes. Construction of the vacuum vessel is described and also the baking procedure for the liner. The vacuum pumping arrangement is also described. (MOW)

8420 (CEA-CONF-2613) VACUUM PROBLEMS IN PLASMA PHYSICS AND CONTROLLED NUCLEAR FUSION. Prevot, F. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1974. 12p. (CONF-740353-1). Dep. NTIS (US Sales Only) $4.00.

From 6th international vacuum congress; Kyoto, Japan (25 Mar 1974).

Vacuum problems in CTR involve a number of new aspects which make them different and often more difficult and complex than in any other fields of application. The first important aspect is the existence of the plasma itself which is at the same time a large source of neutral gas and a powerful internal pump. Interaction between neutral gas and plasma is very different whether the plasma is transparent or opaque to neutral atoms or molecules. The second important aspect is the influence of the walls on plasma pollution by high Z atom induced emission. These two phenomenons play an important role in the energy balance of both laboratory plasmas and future thermonulcear reactors. Concerning the vacuum system of thermonuclear reactor, the enormous size of the vessel and pumping speed requested and some safety problems inherent to tritium handling and neutron activation must be specially mentioned. Several solutions were proposed and partially tested in present experiments, i.e., choice of the material of the wall, baking and surface processing, pumping and auxiliary equipments, magnetic divertor and protective layer of cold plasma. Examples of typical cases are presented and discussed. (auth)

8421 (CEA-CONF-2623) PLASMA WALLS INTERACTIONS IN THE T.F.R. MACHINE. Del Cas, R.; Ginot, P.; Rebut, P. H.; Sledsiewski, S.; Tachon, A.; Torossian, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee'. Jan 1974. 13p. (CONF-740104-22). Dep. NTIS (US Sales Only) $4.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

The T.F.R. is a tokamak-type machine, the vacuum vessel of which consists of thin inconel bellows welded to thicker stainless steel sections. 1100 deuterium discharges have been done up to 200 kA, 40 kG, 2 to 6×10^{13} cm^{-3}, 250 msec. 10 discharges have been performed using a feedback circuit to center the plasma. Doing so the discharge duration has been extended to 400 msec but the experiment was stopped by a sudden break in the vacuum vessel. The machine has been dismantled and the parts of the chamber analyzed. The damage suffered by the limiter is similar to that observed in other tokamaks. Local heat flux impacts were discovered on the bellows, one of which was responsible for the vacuum leak. These impacts, yet unobserved anywhere else, were regularly distributed around the torus and coincide with the corrugations of the main magnetic field. Metallurgical analysis showed local dislocations of the metallic lattice of the bellows. Plasma or runaway particle interactions with the wall are invoked in the discussion. Remarks are made on the construction of the vacuum vessel for future high-performance tokamaks. (auth)

8422 (CONF-741040-1) ADVANCED FUELS FOR NUCLEAR FUSION REACTORS. McNally, J. R. Jr. (Oak Ridge National Lab., Tenn. (USA)). 1974. 16p. Dep. NTIS $4.00.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

Should magnetic confinement of hot plasma prove satisfactory at high β ($16\pi nkT/B^2 > 0.1$), thermonuclear fusion fuels other than D-T may be contemplated for future fusion reactors. The prospect of the advanced fusion fuels D-D and ^{6}Li-D for fusion reactors is quite promising provided the system is large, well reflected and possesses a high β. The first generation reactions produce the very active, energy-rich fuels t and ^{3}He which exhibit a high burnup probability in very hot plasmas. Steady state burning of D-D can ensue in a 60 kG field, 5m reactor for $\beta \sim 0.2$ and reflectivity $R_\mu = 0.9$ provided the confinement time is about 38 sec. The feasibility of steady state burning of ^{6}Li-D has not yet been demonstrated but many important features of such systems still need to be incorporated in the reactivity code. In particular, there is a need for new and improved nuclear cross section data for over 80 reaction possibilities. (auth)

8423 (CONF-741105-39) PLASMA CONTAMINATION AND WALL EROSION IN CONTROLLED THERMONUCLEAR FUSION DEVICES AND REACTORS. Kaminsky, M. S. (Argonne National Lab., Ill. (USA)). 1974. 16p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

During the operation of thermonuclear devices and reactors, the surfaces of such major components as container walls, beam limiters, diverter walls, and beam-dump walls of the injector region will be exposed both to the primary plasma radiations and to secondary radiations from (n,γ), (n,p), (n,α), and other nuclear reactions and from various secondary particle and photon-emission phenomena induced by the primary radiation. Such energetic radiations striking the surfaces of components of fusion devices and reactors can cause a variety of surface phenomena and thereby (a) the release of major quantities of gas which will contaminate the plasma, and (b) the damage and erosion of the bombarded wall. A summary of recent experimental results on plasma contamination and wall erosion due to radiation blistering and the release of particulate matter from solids under irradiations induced by 14-MeV neutrons are presented. (auth)

8424 (GA-A-13150) SILICON CARBIDE AND GRAPHITE MATERIALS FOR FUSION REACTORS. Hopkins, G. R. (General Atomic Co., San Diego, Calif. (USA)). 2 Sep 1974. Contract AT(04-3)-167. 29p. (CONF-741105-38). Dep. NTIS $4.50.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The utilization of low atomic number materials for first-wall and blanket structural materials for fusion reactors and devices is proposed. The low atomic number (Z) materials are important to consider for minimizing radiation losses from plasma impurities (the losses may have a Z^6 dependence) and could be advantageous in present day confinement devices as well as fusion power reactors. Silicon carbide, carbon materials, and mixtures appear as prime candidates. Advantages accruable in a fusion power reactor are (1) very low induced radioactivities for reduction of waste disposal and operational problems, (2) high temperature operation (>1000°C) for high efficiency and low waste heat, and (3) abundant and inexpensive raw material supply. Material properties appear reasonably well suited for fusion reactor application and a technology base is available from High Temperature Gas-Cooled Reactor (fission) as well as many other applications. Significant problem areas for further study are the effects of transmutation products from (n,α) and (n,p) reactions in the materials, and design and fabrication problems for relatively large, high integrity structures with these ceramic, nonductile materials. (auth)

8425 (GA-A-13152) TOKAMAK-DIVERTOR EXPERIMENT IN THE dc OCTOPOLE. Prater, R.; Freeman, R. L.; Hamada, Y.; Moeller, C.; Ohkawa, T.; Tamano, T. (General Atomic Co., San Diego, Calif. (USA)). 2 Sep 1974. Contract AT(04-3)-167. 17p. (CONF-741105-40). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

An Ohmic current has been inductively driven in the dc Octopole. The resulting flux configuration resembles that of a tokamak with axisymmetric divertors. The peak current is 4 kA in a toroidal field of 450 G, and the density on the axis is 4×10^{11} cm^{-3} and the conductivity electron temperature is 27 eV. Because the plasma energy density is low, magnetic probes can be inserted into the plasma for measurements of the plasma current distribution. Magnetic probe traces that are quiet and reproducible at all positions indicate that the plasma has obtained a stable equilibrium. The initial stage of the discharge is very sensitive to error magnetic fields. Plasma current grows until a current disruptive instability occurs, which reduces the peak current density by 40%. At the time of the instability the safety factor q at the axis is estimated to be $q(0) \sim 0.8$, while the $q = 1$ surface is located at the edge of current distribution. The effect of the instability is to redistribute current density from the center of the distribution to the wings. The disruptive instability is characterized by mode numbers $m = 0$, $n = 0$, but it is usually preceded by amplitude saturated fluctuations with $m = 2$, $n = 1$ that are peaked on the $q = 2$ surface. (auth)

8426 (IPP-4/118) ELECTRICALLY TRIGGERED SPARK GAP IN CAPACITOR BANKS. Klement, G.; Wedler, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). May 1974. 67p. (In German). Dep. NTIS (US Sales Only) $6.50.

This study is intended to present as comprehensive as possible a survey of the various spark gap concepts, special emphasis being placed on the historical context. The very complex phenomena leading to pulse breakdown are highly simplified. A special point is made to impress upon the reader that spark gaps in capacitor banks are not maintenance-free because of the heavy duty and have only a comparatively modest service life if the economic framework of such banks is not exceeded. (auth)

8427 (KHFTI-73-20, pp 3-4) SINGLE-CUT THORSATRON WITH THE SPACE MAGNETIC AXIS "VINT-20". Artsebashev, V. I.; Amelin, V. Z.; Vishnevetskii, V. N. 1973. (In Russian).

The basic parameters are given for new thermonuclear equipment, i.e., a toroidal single-cut thorsatron with a Vint-20 space magnetic axis. The equipment was designed for studying the maintenance of a hot and dense plasma in a closed magnetic system of the stellarator type. The equipment was introduced to the country in 1972 at the UkrSSR Academy of Sciences Physico-Engineering Institute. Optimum regimes, which ensure high efficiency of the magnetic field parameters and low-cost construction compared to the usual stellerator with similar characteristics, are discussed. A dense plasma can be held with a temperature of 1 keV, used for high-frequency and turbulent heating, on this equipment. (INIS)

8428 (KHFTI-73-20, pp 5-7) SUPERCONDUCTING CLOSED MAGNETIC SYSTEMS OF "CRYSTAL-1" AND "CRYSTAL-2" INSTALLATIONS. Bredikhin, M. Yu.; Georgievskii, A. V.; Glasov, B. V. 1973. (In Russian).

Development of a stellarator type superconducting system is discussed. The basic problems are: producing a field of some tens of kOe and systems with stored energy of more than 1 MJ with a design current density of 1.5×10^4 oersteds/cm^2; guarantee of sufficient access to the plasma volume for entry into the system; heating and analysis of the plasma; building a cryostat with maximum heat-insulating winding with consideration of the openings and a strong frame, heating, system, and plasma analysis; guarantee of the necessary low vacuum conditions; and construction of a system of cryogenic safety. Many of these problems were studied in the Crystal-1 magnetic system, constructed in 1970, and will be completed on the Crystal-2 thermonuclear trap, now being developed. (INIS)

8429 (KHFTI-73-20, pp 8-9) ELECTROMAGNETIC TRAP "YUPITER-IM". Azovskii, Yu. S.; Georgievskii, A. V.; Ziser, V. E. 1973. (In Russian).

The experimental Jupiter-1 equipment is described. This is a pulsed electromagnetic trap with fields calculated for producing and holding a plasma with thermonuclear properties. The expected plasma density is 10^{14} cm^{-3} at an average ion energy greater than 15 keV; the holding time for a plasma with the given properties should be several milliseconds. The properties of the magnetic field and construction of the electromagnetic system are described. Tests on a model coil are described which indicate that the type of coil and cooling system selected ensure repeated (several hundred) production of a magnetic field of strength up to 200 kOe in a pulse with a length of 10 msec each 2 min. (INIS)

8430 (KHFTI-73-20, pp 12-13) THORSATRON WITH SPIRAL COMPENSATING WINDING. Georgievskii, A. V.; Ziser, V. E.; Popozhev, D. P.; Sergeev, Yu. F. 1973. (In Russian).

A design is given for the magnetic system of a thorsatron, without a special winding of the longitudinal field, which improves the characteristics of the magnetic field and facilitates the operating regime. The compensation winding is in the form of a spiral in which a large number of the cuts are in an opposite direction. The advantages of the system compared to a stellarator are discussed. (INIS)

8431 (KHFTI-73-20, pp 14-21) EFFECT OF THE TRANSVERSE FIELD COMPENSATION METHOD AND SPIRAL WINDING PACKING LAW ON MAGNETIC SURFACES OF A THREE-CUT THORSATRON. Georgievskii, A. V.; Ziser, V. E.; Skoblik, M. N.; Peletminskaya, V. G.; Pogozhev, D. P.; Minaev, V. P. 1973. (In Russian).

A systematic study is presented of the structure of a magnetic field of a three-cut thorsatron with a large toroidality ($\sim$0.3). Calculations were made on a computer. The thorsatron is compared with a stellarator with the same geometric parameters, and the efficiency of the two as a function of the toroidality of the spiral winding is discussed. (tr-auth)

8432 (KHFTI-73-20, pp 22-23) RESEARCH ON THE THORSATRON MAGNETIC SYSTEM WITHOUT A SPECIAL MAGNETIC FIELD WINDING. Georgievskii, A. V.; Ziser, V. E.; Pogozhev, D. P.; Sergeev, Yu. F.; Taran, V. M. 1973. (In Russian).

For studying the properties of magnetic surfaces of a three-turn thorsatron without special winding of the longitudinal magnetic field as a function of the distribution of the compensating magnetic field, a model of the Saturn-I equipment was constructed (similarity coefficient 1:2), which made it possible to make a comparative analysis of the properties of the magnetic surfaces of the traps. The number of spiral windings on the model was greater than on the Saturn-I, which ensured better use of the secondary operating volume. A thorsatron with a high toroidality without special winding was shown to have closed magnetic surfaces with high parameters, effectively filling the operating volume. The difference in the parameters is explained by a difference in the system from the calculated diagram. Such high parameters are achieved by compensation of the perpendicular field by the toroidal cross-section magnetic field. With simultaneous compensation along the radius, the parameters are worse. The angle of rotation along the spiral field is decreased 40%. (INIS)

8433 (KHFTI-73-20, pp 24-28) COMPENSATION OF ELECTRODYNAMIC STRESSES IN TOROIDAL SCREW MAGNETIC SYSTEMS. Georgievskii, A. V.; Ziser, V. E.; Litvinenko, Yu. A.; Skoblik, M. N. 1973. (In Russian).

A systematic theoretical and experimental study was made of the electrodynamic forces acting on the spiral winding of a thorsatron. The purpose was to find conditions under which the forces acting along both the large and small radii of the torus would be minimized and which would give a better magnetic field structure from the standpoint of holding a high-temperature plasma. (tr-auth)

8434 (KHFTI-73-20, pp 29-31) STRENGTH AND HARDNESS OF SUPPORTING BANDS OF STELLARATOR WINDING. Biryukov, O. V.; Vishnevetskii, V. N.; Uglitskii, N. F. 1973. (In Russian).

Strength factors and deformations are presented graphically for support bands of a stellarator winding in the form of a closed ring of unit length, charged with three focusing forces. Diagrams for the bending moments of longitudinal forces, elastic lines, and deviation curves were drawn. Hardness values for two-thickness frames are shown in bending, tensile, and compression. (INIS)

8435 (KHFTI-73-20, pp 32-34) MECHANICAL STRESSES AND DEFORMATIONS IN THE SUPPORT FRAME OF SPIRAL WINDING. Biryukov, O. V.; Uglitskii, N. F. 1973. (In Russian).

Mechanical stress and deformation in the support frame of a spiral winding were studied. The calculation unit used was a thin ring of unit length, intermittently loaded by equally distributed radial weighting. Graphs are shown for determining longitudinal forces of the bending moment and bending angle in a random section of the ring. (INIS)

8436 (KHFTI-73-20, pp 35-36) SERIES OF COILS FOR THE FORMATION OF A MAGNETIC FIELD WITH THE INTENSITY UP TO 200 Koe. Biryukov, O. V.; Georgievskii, A. V.; Ziser, V. E.; Pogozhev, D. P.; Samoilov, V. P.; Sergeev, Yu. F.; Taran, V. M.; Shabel'nikov, L. A. 1973. (In Russian).

A series of coils was made for creating a magnetic field with an intensity of up to 200 kOe. Two types of coils were used, i.e., sectioned and with spool-type multinuclear or spiral winding. In all spools the parasitic components of the magnetic field were compensated. The coils, which were cooled with air or water, had dimensions that were precise to 0.5%. The wrapping was a copper tube, 10 by 10 with 5 × 5 openings. The spools survived, without cracking of the insulation, hundreds of switchings on in a field of 30 to 40 kOe, which agrees with calculations. Many experimental set-ups of plasma laboratories of the UkrSSR Academy of Sciences Physics and Technology Institute have now been equipped with coils that are recommended for many years of use. (INIS)

8437 (KHFTI-73-20, pp 37-39) STATIONARY AND PULSED LOW-TEMPERATURE SOLENOIDS. Skobenko, E. I.; Maslov, A. I.; Yuferov, V. B. 1973. (In Russian).

Tests were made to generalize accumulated work and to supplement data published earlier on fabrication of cryogenic magnetic systems used in thermonuclear studies. The basic parameters of several cryogenic magnets are tabulated. The trouble-free operation time of these solenoids was determined by the number of cooling cycles, i.e., 1 to 2×10^3 cooling cycles and about 10^5 switchings on of the magnetic field. The results, although they relate to an open magnetic system, may be used in fabricating closed magnetic traps including superconductors. (INIS)

8438 (KHFTI-73-20, pp 40-41) TECHNOLOGICAL CHARACTERISTICS OF FABRICATION OF THE "VINT-20" MAGNETIC SYSTEM. Vishnevetskii, V. N.; Georgievskii, A. V.; Zhukov, V. N. 1973. (In Russian).

The technology was developed for making a magnetic system for the Vint-20 apparatus, the main unusual feature of which is a closed toroidal spiral winding in a vacuum container without an inner frame. By chemical etching of the aluminum alloy core with 15% NaOH, a spiral winding was formed without an inner retaining frame with a high precision and a vacuum cleaned surface. (INIS)

8439 (KHFTI-73-20, pp 42-44) FORCE WINDING BENCH OF GLASS-FIBER-REINFORCED PLASTIC FRAMES OF HIGH SUPPORTING POWER ON METALLIC TOROID STELLARATOR CHAMBERS. Biryukov, O. V.; Vishnevetskii, V. N.; Durnov, V. A.; Ivakhnenko, S. F.; Kitaevskii, L. Kh.; Samoilov, V. P.; Sivinskii, Yu. P.; Tkhoryak, F. A. 1973. (In Russian).

A machine was developed for the power winding of glass-plastic bodies of high supporting capacity on metal toroid chambers of stellarators. A table is given showing the comparative properties of coil-winding machines and of toroidal glass-plastic bodies. The design and operation of the machine are illustrated. The machine operation is semiautomatic. With the machine, working samples of spiral windings of a stellarator with high indexes of electric and mechanical strength and having geometric dimensions with the needed precision can be made on the machine. (INIS)

8440 (KHFTI-73-20, pp 45-47) LAG TIME OF COMMUTATORS CONTROLLED BY A PULSED GLOW DISCHARGE. Aksenov, I. I.; Belous, V. A.; Smirnov, S. A. 1973. (In Russian).

The time characteristics of a laboratory model of a commutator regulated by a pulse glow discharge were studied. Measurements were made under conditions of positive displacement on an actuating electrode discharge in a cathode chamber. In the field of the start-up electrode, electrons "drew off" from the zone of the start-up opening in the cathode and leveled off the anode field in these openings, which eventually led to an increase in the electrical stability of the equipment. Graphs are presented which show the dependence of the time lag of the start-up pulse on the anode tension and on the height of the start-up chamber. (INIS)

8441 (KHFTI-73-20, pp 48-49) BURNING VOLTAGE OF A PULSE DISCHARGE WITH A COLD HOLLOW CATHODE. Aksenov, I. I.; Belous, V. A.; Smirnov, S. A. 1973. (In Russian).

The effect of the dimensions of a hollow cathode and a change in the geometry of the commutator on the voltage of a pulsed discharge was studied. Under the conditions used, the decrease in the voltage to acceptable values with a decrease in the diameter of the cathode to about 10 mm. Introduction of a perforated barrier on the anode decreased the discharge. The presence in the hollow cathode of a start-up electrode, delivery to it of negative start-up pulses, and activation of a weak-current attendant discharge affected the discharge slightly. (INIS)

8442 (KHFTI-73-20, pp 50-51) CONTROLLED CURRENT BREAKING IN THE GAS-DISCHARGE DEVICE WITH A COLD HOLLOW CATHODE. Aksenov, I. I.; Nosov, G. I.; Smirnov, S. A. 1973. (In Russian).

Data are reported which verify the suggestion of a possible mechanism of quenching a glowing discharge in a high-voltage gas-discharge commutator with a cold open cathode. Characteristics of the equipment studied are discussed, the equipment being started up by introduction of a pulse of negative polarity on the actuating electrode. The controlled quenching of the charge occurs upon entry of the negative pulse into the closing off electrode. The results show that the greater the amplitude of the quenching pulse the narrower the actuating space, and the lower the pressure the greater the current that may be cut off with other conditions equal. (INIS)

8443 (KHFTI-73-20, pp 52-53) SPECIFIC FEATURE OF DISCHARGE SHAPING IN THE HOLLOW ELECTRODE SYSTEM. Aksenov, I. I.; Belous, V. A.; Smirnov, S. A. 1973. (In Russian).

The possibility was investigated of using a discharge with a hollow cathode for initiating sparkover of a short gas-discharge space under conditions of the left branch of the Pashen curve with possibly a lower expenditure of energy in forming an incendiary pulse. A system of hollow electrodes was studied. The criterion of efficiency of sparkover initiation was the lag time, measured by the interval between the leading front of the spark pulse and the moment of tension drop on the gap to a value determined by the sparking potential of the independent discharge. With negative potentials and current of the guard discharge (I_{st}), sparkover of the gap did not occur. With $I_{st} = 0$, sparkover occurred with a large lag, e.g., around 100 μsec. Special features of the time characteristics of the equipment are explained. (INIS)

8444 (KHFTI-73-20, pp 55-56) GAS-FILLER ABSORPTION IN THE UNSOLDERED HEAVY-CURRENT DISCHARGERS. Bocharov, V. K. 1973. (In Russian).

The absorption of helium, argon, and hydrogen in high-power sealed dischargers of the trigatron type and in commutators with a complete control system was studied in order to create a constant pressure of the gas medium in this equipment. The absorption of hydrogen in prolonged operation of the discharger was studied on equipment in which gas losses were made by means of a Titan generator of hydrogen from the TGII-325/16 thyratron, using an active mass of 0.5 g of metal. The commutator went through two successive regimes of testing on batteries with capacities of 6 μF and 12 μF. As a result of joint work on a generator with 2.35×10^4 keyings in at a 20 kV potential, about 2.5 cc (standard conditions) of hydrogen was absorbed (P = 760 torr, t = 20°C). (INIS)

8445 (KHFTI-73-20, pp 57-58) REGULATION OF THE SHAPE OF A HIGH-CURRENT HIGH-VOLTAGE PULSE, FORMED BY AN ARTIFICIAL LINE. Pivovar, L. I.; Taller, E. G. 1973. (In Russian).

A method was developed for calculating the electronics of the power supply for several pieces of equipment. The diagrams contain active and passive links, including a time lag for the purpose of regulating the shape of the high-current high-voltage pulses. The calculations were made with certain simplifications. The solution of the problem was reduced to observation of the characteristic waves in the chain lines with adjusting elements. The original equations for current were obtained from Kirchhoff's law. The numerical calculation of the system was made by the Runge-Kutte method in three stages according to the sequence of closing of the keys in the diagram. Graphs are presented which show that the calculated shape of the pulse coincides with the shape obtained experimentally. (INIS)

8446 (KHFTI-73-20, pp 59-62) AUTOMATION OF A PHYSICAL EXPERIMENT BY MEANS OF THE DIGITAL COMPUTERS "MIR" AND "DNEPR-1". Zhdanov, A. I.; Nesterenko, P. T.; Sizaya, E. N. 1973. (In Russian).

A method for eliminating a number of shortcomings of a system for automated processing of experimental data is described. The system is applicable to the program for studies on the Uragan stellarator. Insufficient reliability, small calculational capacity, absence of external storage, and only manual programming are eliminated by keying into the computer system. (INIS)

8447 (LA-UR-74-1511) LASER FUSION EXPERIMENTS AT LOS ALAMOS. Part II. The LASL CO_2 Short Pulse Oscillator–Amplifier System. Boyer, K.; Fenstermacher, C. A.; Stratton, T. F. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 9p. (CONF-741105-35). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The short pulse CO_2 laser in operation at Los Alamos was developed to produce a short pulse laser beam for experiments on laser–plasma interactions at 10 μm wavelength and to provide an engineering basis on which larger, more efficient CO_2 lasers can be designed. The laser now generates pulses at 10.6 μm wavelength containing 300 joules in 1.5 ns and is presently being upgraded to produce ~400 to 500 joules. The beam is of good optical quality and can be focused into a diameter of approximately 140 μm. The peak power at the focus reaches 7×10^{14} watts/cm². (auth)

8448 (LA-UR-74-1603) NET APPLICATIONS IN CTR ENGINEERING. Boicourt, G. P.; Hammel, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 6p. (CONF-741001-27). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Most Controlled Thermonuclear Research (CTR) experiments at Los Alamos Scientific Laboratory utilize fast-pulsed circuits. Fast pulses present unique problems to the engineer who must specify the circuit and its constituent components. Transient voltages of unknown size and durations will be present during the discharge, risetimes may be affected by parasitic impedances and the current signature at the load is dependent on the plasma dynamics. Circuits must be designed to reproduce as nearly as possible the plasma conditions required by theory. Such circuits are to be assembled from advanced high-voltage components using state-of-the-art techniques. Given components and techniques, the circuit must be chosen from a group of possible circuits. In some cases components must be developed to satisfy particular circuit functions. NET-2 can be used to calculate voltages and current in components, to optimize waveforms, to predict circuit behavior with plasma present, and to select the best circuit from a group of circuits. Some examples are presented. (auth)

8449 (MATT-Q-31) ANNUAL REPORT COVERING THE PERIOD JANUARY 1–DECEMBER 31, 1973. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Aug 1974. Contract AT(11-1)-3073. 159p. Dep. NTIS $11.00.

A separate abstract was prepared for each of the four sections of the report. (MOW)

For abstracts of individual sections see: 8353, 8354, 8388, and 8450.

8450 (MATT-Q-31, pp 69-99) ENGINEERING AND DEVELOPMENT. Aug 1974.

In annual report covering the period January 1–December 31, 1973.

The year's major project was the continued manufacture of PLT machine component parts and power accessories preparatory to assembly, which is due in May, 1974. Engineering support of existing experimental machines was carried out, as were miscellaneous engineering activities necessary for other laboratory purposes. The Reactor Studies Group completed its second year of operation. (auth)

8451 (NP-20190) INDUSTRIAL PARTICIPATION IN THE FUSION POWER PROGRAM. Program Report: Volume 1, Number 13. Brown, G. E. Jr. (Atomic Industrial Forum, Inc., New York (USA)). Sep 1974. 31p. Atomic Industrial Forum, Inc., New York, NY $10.00.

Research program plans and objectives for both the magnetic confinement and laser fusion programs in the US are outlined. Industrial participation issues concerning both programs are discussed. Areas warranting priority attention are pointed out. (MOW)

8452 (UCID-16156) ASTRON PROGRAM SUMMARY, APRIL–OCTOBER 1972. Fowler, T. K.; Briggs, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Nov 1972. 10p. Dep. NTIS $4.00.

The Astron program in relation to its goal of field reversal is described. Resistor modifications are discussed. Electron layer trapping is described for different configurations. An outline is given of the program plans. (MOW)

8453 (UCRL-75827) SOME CONSIDERATIONS OF MATERIALS REQUIREMENTS FOR MIRROR FUSION REACTORS. Pittenger, L. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Aug 1974. 15p. (CONF-740804-4). Dep. NTIS $4.00.

From American Institute of Chemical Engineers; Salt Lake City, Utah, USA (18 Aug 1974).

A model mirror fusion reactor is examined in order to identify materials problems which are of special importance to mirror machines. The high fuel throughput and use of a direct converter make considerations of wall damage problems different in several respects than in toroidal devices. High magnetic fields in mirror machines require more advanced superconducting technology than is necessary for toroidal devices. Steady-state mirror operation, as opposed to short or long pulsed operation of other systems, makes materials fatigue less a matter of concern. (auth)

8454 DESIGN CONSIDERATIONS FOR A SIMULATION EXPERIMENT TO INVESTIGATE CTR PLASMA–WALL INTERACTION. Kupschus, P. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Technische Physik). J. Nucl. Mater.; 53: 97-101(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The design philosophy and a short description of an experimental facility under construction are given. Its purpose is to test targets (diameter of the order of 10 cm) for long-time exposure to a plasma or particle beam of hydrogen at fusion energies and proper flux densities, generated using a multi-aperture ion source as well as a Hall accelerator and an electron-cyclotron RF accelerator. The primary effort will be to concentrate on the problem area around divertor plates. Cryo pumps will provide a background pressure of cold neutral gas ranging from 10^{-4} to 10^{-1} torr. The target is immersed in a magnetic field of up to 10 kG which serves to more realistically influence plasma conditions at the target. The facility will serve to investigate surface effects on materials of interest for the reactor design. Special emphasis will be placed on the correlation between erosion rates and plasma conditions at the surface of the target. (auth)

8455 ON THE IMPURITY PROBLEM IN QUASI STEADY-STATE TOROIDAL PLASMA EXPERIMENTS AND FUSION REACTORS. Duechs, D.; Haas, G.; Pfirsch, D.; Vernickel, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). J. Nucl. Mater.; 53: 102-106(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

A simple equation for estimating the impurity build-up in a plasma due to sputtering is discussed under various assumptions. It is shown that the D-T burning time in an experiment (or reactor) without a divertor or cold gas blanket is one particle confinement time at most. If the accumulation of impurities in the center of the plasma cannot be avoided, steady-state operation of a reactor even with a divertor will not be achievable. The effect of neutron sputtering is included in the discussion. (auth)

8456 THERMAL STRESS PROBLEMS IN TOKAMAK SURFACES. Schivell, J. F.; Grove, D. J. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). J. Nucl. Mater.; 53: 107-110 (Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The density of power deposited on some surfaces of a tokamak can easily reach the level where the surface may be destroyed by thermal stress. This report is an examination of the thermal stress problem under tokamak conditions. The magnitude of the maximum power density is given for some existing and future devices. As examples which furnish a guide to power absorption limits for surfaces in high-power plasma devices, estimates have been made of thermal stress in a thick wall subjected to transient heating on one side. Also, detailed results are given for a flat plate heated on one face and cooled on the other. Comparative power density limits are tabulated for various materials of interest for plasma device construction. (auth)

8457 A STUDY OF HOT PLASMA IN CONTACT WITH A COLD WALL. Feinberg, B.; Gross, R. A. (Columbia Univ., New York (USA). Plasma Lab.). J. Nucl. Mater.; 53: 111-114 (Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

A study has been made of the energy transfer from a hot ($T \sim 5 \times 10^6$ K) plasma containing a strong magnetic field brought into sudden contact with a cold wall. The rate of energy transfer has been measured and compared with theoretical predictions. Photographs obtained with a scanning electron microscope of wall surface damage are presented. (auth)

8458 RADIATION BLISTERING OF STRUCTURAL MATERIALS FOR FUSION DEVICES AND REACTORS. Das, S. K.; Kaminsky, M. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 115-126(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Radiation blistering can be an important erosion process when the structural components of controlled thermonuclear fusion devices or reactors are exposed to the impact of energetic particles leaving the plasma region. A brief review of some of the important parameters governing the radiation blistering process is given. Erosion rates associated with helium blistering in V, Nb and Type 304 stainless steel are reported for different irradiation temperatures and different projectile energies. (auth)

8459 HELIUM AND HYDROGEN RE-EMISSION DURING IMPLANTATION OF MOLYBDENUM, VANADIUM AND STAINLESS STEEL. Bauer, W.; Thomas, G. J. (Sandia Labs., Livermore, Calif. (USA)). J. Nucl. Mater.; 53: 127-133(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

He re-emission has been measured during 300 keV He^+ implantation from 400°C to 1200°C in V and Mo and between −170°C and 700°C in 316 SS. H re-emission has been measured during 150 keV H^+ implantation of Mo, V, and 316 SS between −90°C and 115°C. In general the He re-emission is low until a critical dose is reached, at which time the re-emission abruptly rises to higher values. Both the critical dose and re-emission are strongly temperature dependent. The H re-emission generally rises smoothly to an equilibrium value which is both temperature and material dependent. Only at the lowest temperature does the H re-emission in Mo bear a qualitative resemblance to He re-emission. (auth)

8460 SURFACE DEFORMATION IN He AND H IMPLANTED METALS. Thomas, G. J.; Bauer, W. (Sandia Labs., Livermore, Calif. (USA)). J. Nucl. Mater.; 53: 134-141(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The surface deformations produced by high-dose He and H implantations in Mo, 316 stainless steel, and V have been studied using scanning electron microscopy. It was found that He implantation produces surface deformation in all three materials at temperatures ranging from −170°C to 1200°C. In contrast, H implantation produced blistering only in Mo and stainless steel implanted at low temperatures. (auth)

8461 PRELIMINARY OBSERVATIONS OF BLISTERING OF NIOBIUM BY 1−15 keV HELIUM IONS. Martel, J. G.; St-Jacques, R.; Terreault, B.; Veilleux, G. (Quebec Univ., Varennes (Canada). Energy Research Centre). J. Nucl. Mater.; 53: 142-146(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Polycrystalline targets of cold-rolled Marz grade niobium were bombarded at room temperature with beams of helium ions of 1, 5, 10 and 15 keV at doses varying from 0.1 to 10.0 C/cm^2. The doses were chosen so as to obtain surfaces where the thickness removed by sputtering is respectively less than, comparable to, and greater than the implantation depths. The targets were not further treated beyond mechanical polishing. The vacuum during bombardment was 2×10^{-8} torr. Blisters of 0.1 to 3.0 μm size have been observed. The blister covered area increases with dose up to a point, but at the higher doses the blisters, if any, are masked by a micro-relief of wide valleys presumably sputtering-induced, and tiny pock-marks which could be small ruptured helium blisters. (auth)

8462 BLISTERING OF NIOBIUM DUE TO 0.5 TO 9 keV HELIUM AND HYDROGEN BOMBARDMENT. Roth, J.; Behrisch, R.; Scherzer, B. M. U. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). J. Nucl. Mater.; 53: 147-153(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Blistering of well-annealed niobium single crystals due to 0.5 to 9 keV helium and hydrogen ion bombardment at temperatures between −110°C and 1000°C has been investigated by Rutherford backscattering (RIBS) in double alignment and with a scanning electron microscope (SEM). For He bombardment blistering was observed by RIBS in the temperature range investigated for all energies above 1 keV. The critical dose at which blisters first appear is about 1 to 2×10^{17} incident He ions per cm^2. It increases slightly with increasing energy and with decreasing target temperature. Blisters of 500 to 5000 Å in diameter were found. The depth at which the blisters develop increases from ~180 Å for 1 keV to 1100 Å for 9 keV He ions. It is a factor of ~3 larger than the theoretical mean range of the ions in amorphous material. Above ~600°C grain boundaries develop extending also into the unbombarded region. For hydrogen bombardment no blistering could be observed at room temperature up to doses of 2×10^{19} ions per cm^2. (auth)

8463 PARTICLE RE-EMISSION DURING IRRADIATION. Wilson, W. D.; Bisson, C. L. (Sandia Labs., Livermore, Calif. (USA)); Amos, D. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). J. Nucl. Mater.; 53: 154-161(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

A model of implanted gas concentration leading to surface blistering and re-emission of particles during irradiation is presented. The model assumes that particles diffuse from a Gaussian source which is independent of time and involves the solution of the time-dependent diffusion equation with a source term. The source is calculated assuming a Gaussian form with range and straggling obtained from Lindhard-Scharff-Schiott theory. The solution involves the Green's function for a general source term and finally a numerical integration. The re-emitted flux due to diffusion is also calculated as a function of time. The maximum concentration $C_m(\chi,t)$ of particles in the solid at distance χ from the surface at any time t is the crucial parameter. When $C_m \geq p_c NA$ anywhere in the implanted material, an interconnected region is assumed to form. N is the atomic density of the target material and A the area of implant. The critical concentration p_c is taken to be the concentration required for the onset of percolation ($p_c \simeq 0.24$ for a b.c.c. lattice). An effective diffusion coefficient for He in Nb at ~400°C (and Pd at −170°C) is extracted from experimental data and used to predict the dependence of the critical dose on the current density. The fractional release and rate of re-emission during irradiation are also calculated as a function of implanted dose. (auth)

8464 PARTICLE EMISSION FROM SOLIDS UNDER 14 MeV NEUTRON IMPACT. Kominsky, M.; Das, S. K. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 162-170(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The recent studies of particle emission from cold-rolled niobium under 14 MeV neutron impact were extended to annealed polycrystalline niobium surfaces with various surface finishes. The type and amount of material released and deposited on a substrate surface were determined independently by four analytical techniques. Again, two types of deposits were discovered, —one in the form of large chunks, the other a more even layer covering the surface. The chunk deposits are not uniformly distributed over the collector area but are clustered along certain streaks or appear in certain patches. The direction of the streaks appears to be parallel to the direction of cold-rolling of the niobium sample and is not related to any microstructure of the collector surface. The number of deposited chunks decreases by about a factor of 25 if one irradiates an annealed polycrystalline niobium surface with a microfinish of ≃ 0.5 μm instead of a cold-rolled niobium surface with a microfinish of only ~5 μm. (auth)

8465 SHOCK WAVE INTERACTIONS ARISING FROM NEAR SURFACE DISPLACEMENT CASCADES. Guinan, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). J. Nucl. Mater.; 53: 171-178(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Kaminsky has recently observed during 14 MeV neutron irradiation of a variety of materials that substantial (micron-sized) particles are ejected from the surfaces of the bombarded specimens. Similarities between Kaminsky's observations and the macroscopic phenomena of spall suggested the possibility that shock waves and transient thermal stresses, generated by energetic primary knock-ons, may be in part responsible. A brief discussion of spall phenomena will be presented as background to calculations of the shock wave interactions. The results indicate that cascade generated stresses may be responsible for the emission of such particles by triggering the release of stored internal energy. (auth)

8466 NEUTRON SPUTTERING OF GOLD. Kirk, M. A.; Blewitt, T. H.; Klank, A. C.; Scott, T. L.; Malewicki, R. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 179-182(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The sputtering yield of gold bombarded with fission neutrons was studied in the CP-5 reactor. The experiment was designed to investigate sputtering patterns in addition to the sputtering yield. The investigation was carried out on bulk single crystals and near liquid helium temperature. Overall sputtering yields ranged from 1×10^{-3} to 6×10^{-3} sputtered gold atoms per incident neutron for doses ranging from 2.1×10^{17} to 5.5×10^{17} (nvt > 0.1 MeV). These results are roughly an order of magnitude larger than many previously reported sputtering yields. Sputtering patterns have not been pursued yet, due to prohibitively high background radiation. (auth)

8467 SPUTTERING YIELDS OF Au BY 14 MeV NEUTRONS AND EMISSION OF RECOILS FROM (n,2n) REACTIONS IN Au AND Nb. Behrisch, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)); Gaehler, R.; Kalus, J. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). J. Nucl. Mater.; 53: 183-188(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Forward- and backward-sputtering yields have been determined for 14 MeV neutrons on Au. The 14 MeV neutrons were produced by a DT reaction with a 600 keV accelerator. The sputtered Au was collected on pure Si wafers and quantitatively measured by neutron activation. For a total dose of 1.9×10^{14} neutrons/cm^2 the sputtering yields were 3.3×10^{-4} atoms/neutron for forward and 2.6×10^{-4} atoms/neutron for backward sputtering. Further the number of recoils from (n,2n) reactions emitted from the surface has been measured for Au and Nb in both the forward and backward directions. (auth)

8468 PARTICLE EMISSION BY FISSION. Blewitt, T. H.; Kirk, M. A.; Busch, D. E.; Klank, A. C.; Scott, T. L. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 189-193(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The sputtering by fission fragments of Cu, Al and Nb doped with 0.1 at. % ^{235}U and bombarded with thermal neutrons has been investigated. This was primarily a search for micron-size particles emitted from the surfaces of the doped sources. Kaminsky et al. have observed large particles (several microns in size) emitted from the surface of samples bombarded by 14 MeV neutrons, with a maximum knock-on energy of 600 keV in Nb. The fission energy deposition of 200 MeV should be more than adequate to yield any observable effects that might be present at 600 keV. The concentration of fission events was 10 times the concentration of primary knock-ons in the Kaminsky experiments. With scanning electron microscope and energy dispersive x-ray analyses of our sputtering collectors both before and after irradiation, we found no sputtered particles larger than our detection limit of 0.1 μm. (auth)

8469 SPUTTERING AND CHUNK EJECTION FROM UO_2 AND METALLIC LAYERS DEPOSITED ON UO_2. Biersack, J. P.; Fink, D.; Mertens, P. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). J. Nucl. Mater.; 53: 194-200(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The method of detecting U-235 by means of fission tracks in mica is applied to obtain the sputter yield of fission fragments in UO_2. Single tracks of U atoms, as well as starlike formations of a multitude of tracks are observed which result from larger UO_2 chunks ejected from highly damaged surfaces. The dependence of single atom sputtering on the thickness of the target layer is investigated in detail. Dose dependence is studied mainly with regard to chunk ejection, which is found to depend on damage, and also on surface condition. Inspection of the UO_2 surface reveals the appearance of small craters after irradiation. (auth)

8470 REMARKS ON THE THEORY OF FAST NEUTRON SPUTTERING. Robinson, M. T. (Oak Ridge National Lab., Tenn. (USA)). J. Nucl. Mater.; 53: 201-206(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Theoretical estimates of neutron sputtering yields are in serious disagreement with experiment, unlike the situation with ion sputtering. Possible reasons for the discrepancy are sought without success. It is shown that chunk ejection by neutrons is not due to either single neutron events or to the dynamic interference of cascades. The need for more complete experimental data to guide development of the theory is emphasized. (auth)

8471 SECOND PHASE FORMATION AT MICROVOIDS AND GAS ATOM ENTRAPMENT AT FUSION REACTOR FIRST WALL SURFACES. Beeler, J. R. Jr. (North Carolina State Univ., Raleigh (USA)). J. Nucl. Mater.; 53: 207-212(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Results of cascade production and annealing studies for iron are projected to the currently considered fusion reactor first wall materials. Collision cascades initiated by primary knock-on atoms (PKA) with energies above 50 keV, in iron, separate into distinct subregions. Most PKA produced during fission reactor neutron irradiation have energies below 50 keV, but the energies of PKA produced by 14.1 MeV neutron irradiation commonly lie in the 50-500 keV range in iron and vanadium alloys. Computer experiment simulation indicates that, when present, carbon, silicon, and nitrogen, freed by irradiation from bulk precipitates, should tend to re-precipitate on the facets of microvoids which form in cascade subregions during short-term annealing. (auth)

8472 HEAVY PARTICLE RANGE AND ENERGY DEPOSITION DISTRIBUTIONS IN SOLIDS. Brice, D. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). J. Nucl. Mater.; 53: 213-219(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The transport equations describing incident ion locations as they slow to a stop in a solid target have been derived and solved in the approximation of a Gaussian distribution. These distributions have then been used to determine the local rate at which energy is deposited into structural damage and ionization by both the incident ion and the recoiling target atoms. Incident particle and energy deposition distributions are readily and easily obtained through this method for both simple and compound targets, including in particular those alloys and compounds of direct interest in CTR studies. The calculated final particle distributions have been found to agree well with experiment and the calculated damage energy distributions correlate well with measured distributions of simple and complex defects. The results of such calculations provide the first step in understanding the details of individual 14 MeV neutron damage clusters. (auth)

8473 CHEMICAL EFFECTS OF THERMONUCLEAR PLASMA INTERACTIONS WITH INSULATOR AND METAL SURFACES. Gruen, D. M. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 220-225(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The interactions of chemically reactive ions with insulator and metal surfaces result in specific chemical effects which must be considered in sputtering, blistering, trapping and re-emission processes involving these projectiles. Chemical sputtering and chemical trapping of ion beam flux are examples of chemical interaction effects which are discussed. Bombardment of a niobium surface by oxygen and nitrogen ions results in the formation of sputtered niobium oxide and nitride molecules. The molecular species are identified and characterized by means of their vibrational spectra using isotopic substitution and matrix isolation techniques. Results using matrix isolation spectroscopy for both physical and chemical sputtering studies on materials of CTR interest are presented. Chemical trapping is evaluated as a method of chemically pumping the major fraction of the ion beam flux in the divertor of next generation tokamaks. (auth)

8474 LIGHT ION BOMBARDMENT SPUTTERING, STRESS BUILDUP, AND ENHANCED SURFACE CONTAMINATION. Eernisse, E. P. (Sandia Labs., Albuquerque, N. Mex. (USA)). J. Nucl. Mater.; 53: 226-230(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Several effects of high fluence light ion bombardment which are relevant to fusion reactor inner wall problems are under investigation. The impurity loading and lateral stress from high fluence ion bombardments can alter sputtering yields markedly. This is demonstrated with sputtering measurements of 45 keV Kr incident upon Au. Sputtering yields for 150 keV^{4} He onto Au are presented for two different background hydrocarbon partial pressures during bombardment. It is shown that there is a polymerized hydrocarbon buildup on the surface for hydrocarbon partial pressures greater than 1×10^{-10}mm Hg even for ion current densities ranging as high as 4 μA/cm^{2}; true sputtering of the Au has been observed only for lower hydrocarbon partial pressures. Additional effects of oxidizing background gases on sputtering measurements of reactive metals are discussed. It is concluded that the background gas partial pressures, temperatures, and particle fluxes in a fusion device and in simulation experiments must be well defined before sputtering effects can be understood. (auth)

8475 SPUTTERING FROM ENERGETIC SELF-ION CASCADES. Merkle, K. L.; Pronko, P. P. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 231-237(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The rather high primary recoil energies that occur under 14 MeV neutron irradiation can be simulated by self-ion bombardment. However, the primary ion always starts at the entrance surface when self-ion bombardment is used. To examine the effects of cascades in which the momentum of the primary atom is directed towards an exit surface, one has to introduce a second surface that will intersect the cascade in the forward direction. Self-ion transmission sputtering on very thin films has been used for this purpose. The analysis was done in situ by He^{+} backscattering. A backsputtering yield of 120 atoms/ion was observed at 540 keV. At the same energy a forward sputtering yield of 70 atoms/ion is obtained for a film of 660 Å in thickness. These yields are in order of magnitude agreement with theoretical estimates, however, the results seem to indicate that collective and lattice effects play a significant role. It was observed that a tensile stress is built up in the films during irradiation, leading to flattening and rupturing of the film along preexisting faults. (auth)

8476 ION BOMBARDMENT OF INSULATORS. Primak, W. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 238-245 (Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Some of the effects which were observed when some stable inorganic insulators were subjected to ion bombardment are described. Most of the results were for bombardment at room temperature with the light ions H^{+}, D^{+}, He^{+}, having energies in the neighborhood of 100 keV. Phenomena associated with destruction of the surface: stress, deformation, fracture, and blistering, are emphasized. (auth)

8477 ION BEAM STUDIES OF H AND He IN METALS. Picraux, S. T.; Vook, F. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). J. Nucl. Mater.; 53: 246-251(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The use of ion beams to study hydrogen and helium in metals is demonstrated. The ^{3}He (d,p)^{4}He nuclear reaction previously has been used together with ion channeling to determine the lattice locations of ion-implanted D and ^{3}He in tungsten. Preliminary results applying these techniques to helium bubble and blister formation in tungsten are also presented and show that changes attributed to helium bubble formation are observed in tungsten at a He fluence as low as 6×10^{16} He/cm^{2}. The retention of ion-implanted deuterium in W, Au, and Pd surfaces is shown to be greatly enhanced by prior He ion-induced lattice damage. The amount of the damage trapping is also found to depend on whether the metal is in single crystal or polycrystalline form. (auth)

8478 RESOLUTION ENHANCEMENT OF THE ^{3}He(d,p)^{4}He RESONANCE FOR PROFILING HELIUM IN SOLIDS. Pronko, P. P. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 252-256 (Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The use of nuclear resonances techniques for characterizing the distribution and lattice location of implanted atoms in metals is a direct and, in principle, simple method for studying helium and hydrogen gas in CTR first wall materials. However, the reaction ^{3}He(d,p)^{4}He, has a broad (350 keV) half-width in the resonance yield curve. When using a deuteron beam, under normal probing conditions, to measure helium distributions in metals, a rather low stopping power results in limited resolution of about 3 μm. In many cases resolution of a few thousand angstroms or better is necessary. Two resolution enhancement methods have been experimentally examined and results reported in a previous article. This paper reviews those results and examines limitations of resolution enhancement that are obtainable through geometrical and mathematical techniques. (auth)

8479 DEPTH DISTRIBUTION PROFILING OF DEUTERIUM AND ^{3}He. Langley, R. A.; Picraux, S. T.; Vook, F. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). J. Nucl. Mater.; 53: 257-261 (Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

A technique using nuclear microanalysis has been developed to determine ^{2}D and ^{3}He concentration versus depth profiles in the near surface regions (~2 μm) of solids. Ultimate near-surface depth resolutions of ~100 Å should be attainable by these techniques. A probing beam of ^{3}He ions is used to analyze for the deuterium. By energy analyzing the emitted ^{4}He ions from the reaction d(^{3}He,p)^{4}He and by simple computer analysis, deuterium concentration versus depth profiles are obtained. The same methods are applicable for ^{3}He profiling except in that case a ^{2}D probing beam is used. This technique is currently being developed using Er hydride and Sc hydride films. It is particularly suited for the study of the transition metals with high hydrogen solubility such as Nb and V which are of interest for CTR reactor applications. (auth)

8480 DECHANNELING OF FAST PARTICLES BY LATTICE DEFECTS. Quere, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). J. Nucl. Mater.; 53: 262-267 (Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Channeling is one of the numerous phenomena occurring near the surface of any crystalline material irradiated by fast particles. Dechanneling by lattice defects—and in particular by the defects created by the irradiation itself—may play a significant role in such phenomena as sputtering and blistering. It is first shown that dechanneling can be due to an obstruction, to the deformation of the lattice or to both simultaneously. Results of calculation of dechanneling cross sections for some defects are presented. Experimental evidence of dechanneling is described for such defects as (1) grain (or twin) boundaries, (2) stacking faults, (3) dislocations, (4) interstitial atoms, (5) radiation-induced defects, (6) gas bubbles, (7) Guinier-Preston zones, and (8) anti-phase boundaries. Dechanneling cross sections have been measured accurately in cases (1)–(4). The experimental values are in very satisfactory agreement with the theoretical estimates. For example, the dechanneling width of a straight dislocation, in aluminium, for α-particles (5 MeV) channeled along $\{111\}$ planes, is found to be equal to 140 ± 40 Å, whereas calculation gives 175 Å. (auth)

8481 PROTON BACKSCATTERING AS A TECHNIQUE FOR LIGHT ION SURFACE INTERACTION STUDIES IN CTR MATERIALS INVESTIGATIONS. Blewer, R. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). J. Nucl. Mater.; 53: 268-275(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Analysis of near-surface helium and hydrogen isotope depth profiles by a specialized proton backscattering technique has been demonstrated as a means to characterize the concentration, initial position, and subsequent migration behavior of all low Z atom species (except ^{1}H) in metals. The projected range (R_p) of helium implanted at 50 keV in Nb, V, Ti and Cu has been measured and, for the latter two metals, has been found to agree with theoretical calculations within 100 Å (3%). Deuterium has also been detected and profiled (in Ti) using this technique. Detection sensitivity has been demonstrated at the 7 at % level for D in Ti and at the 0.5 at % level for ^{4}He in Cu. In addition, surface and bulk distributions of carbon, oxygen and ^{3}He have been profiled and, in principle, the depth distributions of tritium, ^{6}Li, ^{7}Li, Be, B, N, and F are also simultaneously resolvable if contained within the foil samples. The technique has been used to investigate the effect of radiation damage and in situ annealing on implanted helium profiles in copper. From these observations the mechanism for helium release from the end-of-range location has been delineated. (auth)

8482 ENERGY DISTRIBUTIONS OF CHARGED AND NEUTRAL HYDROGEN ATOMS BACKSCATTERED FROM METAL SURFACES BOMBARDED WITH 5 TO 18 keV PROTONS. Meischner, P.; Verbeek, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). J. Nucl. Mater.; 53: 276-280(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Polycrystalline targets of Be, V, Nb, Mo and Ta have been bombarded with protons with primary energies in the range from 5 to 18 keV. The energy distributions of the charged and the neutral particles backscattered at 135° with respect to the primary beam direction have been measured between 200 eV and 18 keV. The energy distribution of the neutrals has a pronounced maximum between 0.5 and 1 keV whose position does not depend on the primary energy or the target material, or the angle of emergence of the scattered particles. The energy distribution of the charged particles shows a less pronounced maximum between 1 and 1.5 keV. Only slight differences in the shape of the energy distributions have been observed for different target materials. The fractional number of charged backscattered particles increases from ~3% at 300 eV to ~40% at 18 keV. (auth)

8483 ADSORPTION AND SOLUTION OF HYDROGEN IN SINGLE CRYSTAL NIOBIUM. Hagen, D. I.; Donaldson, E. E. (Washington State Univ., Pullman (USA). Dept. of Physics). J. Nucl. Mater.; 53: 281-284(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Hydrogen adsorbs on the (100) face of niobium at 90 K into at least two states sequentially. The first state, which appears to be molecular, has a dipole moment of −0.022 Debye/molecule, an initial sticking coefficient of 0.23, and a saturation coverage of 3.2×10^{14} molecules/cm^2 reached after an exposure of about 1 L (1 L = 10^{-6} torr·sec). The first state may be a precursor for adsorption into the second state. The second state is atomic and has a dipole moment of −0.141 Debye/atom, an initial sticking coefficient of 0.056, and a saturation coverage of 9×10^{14} atoms/cm^2, which is reached after an exposure of about 12 L. The heat of adsorption for state 2 was found to be 26.5 ± 3 kcal/mol. (auth)

8484 ELECTRON- AND PHOTON-INDUCED DESORPTION. Lichtman, D. (Wisconsin Univ., Milwaukee (USA)). J. Nucl. Mater.; 53: 285-288(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The process of electron and photon induced desorption as a quantum effect (that is, as opposed to thermal effects) has now been firmly established. Considerable data exists on electron induced desorption in the low energy range of approximately 0−200 eV. It now seems certain that these low energy electrons interact directly with the adsorbed gas species and that desorption effects are fairly independent of the substrate material. Results from several laboratories showing the similarity of data for carbon monoxide adsorption and desorption on different metals will be discussed as a typical system. True photodesorption has now been established but is based on very much fewer experimental results. Recent data seem to indicate that the photodesorption process involves first absorption by the substrate with desorption occurring via a secondary process. Thus, the photodesorption process is very much substrate dependent. Recent results obtained on a number of different substrate materials will be discussed and the possible mechanism considered. (auth)

8485 INFLUENCE OF ELECTRIC FIELDS AND GAS ADSORPTION ON THE SURFACE SELF-DIFFUSION OF METALS AND ON THE GROWTH OF MICROCRYSTALLITES. Vanselow, R. (Wisconsin Univ., Milwaukee (USA). Dept. of Chemistry). J. Nucl. Mater.; 53: 289-292(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

A survey of the influence of electric fields and impurities upon surface rearrangements of the refractory metals W, Ta, and Nb is given. This includes the measurement of activation energies for surface self-diffusion at high electric fields (≃ 2×10^7 V/cm) and the surface structural changes at low fields (≃ 2 V/cm, dc-effect). The influence of the electric field on crystallite (whisker) growth is discussed briefly. (auth)

8486 SURFACE PHENOMENA AT FLUID-STRUCTURE INTERFACES AND THEIR EFFECTS ON THE MIGRATION OF TRITIUM IN CONTROLLED THERMONUCLEAR DEVICES. Maroni, V. A. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 293-298(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Phenomena that are likely to have a significant effect on tritium migration through the structural materials of fusion reactors include Langmuir adsorption/desorption, isotopic swamping resulting from the presence of large quantities of protium and/or deuterium, passivation of metal surfaces due to impurity layers, and surface fluxing in the presence of reactive fluids like lithium and some molten salts. These phenomena are considered in terms of their anticipated relative importance under a variety of conditions that could be encountered in fusion devices. In addition, the utility of the Ion Microprobe Mass Analyzer as a tool for studying surface characteristics is discussed, and results of some recent experimental studies of the effect of surface impurities on the hydrogen permeability of vanadium are presented. (auth)

8487 SURFACE EFFECTS ON TRITIUM DIFFUSION IN NIOBIUM, ZIRCONIUM AND STAINLESS STEEL. Elleman, T. S.; Verghese, K. (North Carolina State Univ., Raleigh (USA). Dept. of Nuclear Engineering). J. Nucl. Mater.; 53: 299-306(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Tritium diffusion in niobium, Zircaloy-2 and stainless steel has been studied by measurement of both tritium concentration profiles and surface tritium release rates. Concentration profiles show buildup of tritium in the surface layers of a specimen with classical diffusion behavior at depths greater than about 5 μm from the surface. Application of a two-region diffusion model to the experimental data gives tritium diffusion coefficients in the surface films which are lower than the bulk diffusion coefficients by two orders of magnitude in stainless steel and eight to ten orders of magnitude in niobium and Zircaloy over a temperature range of interest for fission and fusion reactor systems. The surface effect appears to be a consequence of oxide film formation and is not due to the helium injected into specimens along with the tritium. (auth)

8488 DEUTERIUM PERMEATION THROUGH 309S STAINLESS STEEL WITH THIN, CHARACTERIZED OXIDES. Swansiger, W. A.; Musket, R. G.; Weirick, L. J.; Bauer, W. (Sandia Labs., Livermore, Calif. (USA)). J. Nucl. Mater.; 53: 307-312(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Results from deuterium permeation through 309S stainless steel have been combined with oxide growth and characterization information to establish the effects of surface oxides on permeation. Permeation results for 0.25 mm thick diaphragms were obtained using an all-metal, ion-pumped vacuum system and a quadrupole mass spectrometer. The temperature range covered was 250 to 450°C with an upstream deuterium pressure of 100 torr. Analysis by sputter-through Auger electron spectroscopy (AES) revealed that some oxides were reduced or altered by the permeation process. The study included oxide thicknesses of 100 to 2500 Å grown by various procedures. Other characterization techniques employed were proton-induced x-ray spectroscopy (PIX), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). The oxides investigated were found to have only a minor effect on the measured permeabilities. (auth)

8489 PROPERTIES OF HYDRIDE-FORMING METALS AND OF MULTILAYER HYDROGEN PERMEATION BARRIERS. Guthrie, J. W.; Beavis, L. C.; Begeal, D. R.; Perkins, W. G.

(Sandia Labs., Albuquerque, N. Mex. (USA)). J. Nucl. Mater.; 53: 313-322(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Interference microscopy and scanning electron microscopy have been used to measure mechanical effects of tritium decay and ^{3}He accumulation in thin film tritides of Sc, Ti, Y, Ho, and Er, all of which exhibit thickness increase of 2 – 4% y^{-1}, followed by the development of bubbles and craters and the occurrence of significant mechanical film failure. Scandium and erbium deuterotritide films have been subjected to 20 keV N_2^+ ion bombardment in an ion microprobe mass analyzer to produce sputter ion species characteristic not only of the original film (e.g., M^+, MO^+, MD^+, MT^+) but also of compounds formed during the sputtering operation (e.g., ScN^+). Hydrogen isotope permeation has been measured for the homogeneous metals Cu, Ceramvar and Mo, for a Ceramvar-copper-Ceramvar laminate, and for tin-coated Rodar. Measured permeation rates through the laminate are significantly less than those predicted from the permeabilities of its individual constituents. Permeation rates of deuterium through Mo exhibit a somewhat lower activation energy than has been reported in the literature. (auth)

8490 FORMATION AND USE OF OXIDE FILMS TO IMPEDE OUTGASSING OF METALS. Strehlow, R. A.; Savage, H. C. (Oak Ridge National Lab., Tenn. (USA)). J. Nucl. Mater.; 53: 323-327 (Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Phenomena associated with the outgassing of metals are generally interpreted by using models based either on desorption of compounds from the surface or on diffusion of dissolved gases from the interior of the metal. It is generally recognized that surface oxide films can serve to decrease outgassing rates of metals. However, the processes associated with the outgassing of oxidized or oxide-coated metals are not well understood. Outgassing of oxidized metals is considered in light of the results of recent studies of hydrogen permeation through metals with well-characterized oxide films. The chemical stabilities of the oxides, as well as the physical imperfections of the film, are considered. A model is suggested for the expected outgassing behavior of oxidized steels at temperatures which are of interest in the design of controlled thermonuclear research experiments and reactors. The role of impurities and the usefulness of specialized oxidation treatments are discussed. (auth)

8491 DAMAGE AND RANGE PROFILES OF LITHIUM IMPLANTED INTO NIOBIUM. Biersack, J. P.; Fink, D. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). J. Nucl. Mater.; 53: 328-331(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Depth distributions of Li-6 implanted into niobium, and the alteration of these profiles by diffusion are measured through the energy spectra of α-particles emitted after ^{6}Li(n,α) T reactions. Moreover, at high-temperature implantation, radiation damage profiles are detected through Li atoms which are found to be trapped at point defects. By studying channeling or blocking effects in the angular distribution of emitted t and α particles, the lattice locations of Li atoms in niobium can also be obtained. The results of the present experiments are: (i) Range distributions agree in shape with theoretical predictions up to the third moment of the distribution, but absolute values of mean range, width, and skewness are about 23% smaller than predicted by current theories. (ii) Rapid diffusion of interstitial Li is observed during implantation at 683°C, while trapped Li atoms still remain immobile. (iii) Damage distributions (presumably vacancy concentrations) agree with theoretical predictions up to the third moment, except for the same scale factor as found in the range distribution. (auth)

8492 EFFECTS OF NEUTRON-INDUCED ION IMPLANTATION INTO BLANKET STRUCTURAL MATERIALS. Altenhein, F. K.; Andresen, H.; Lutze, W.; Malow, G.; Migge, H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). J. Nucl. Mater.; 53: 332-335(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The high flux of energetic neutrons in CTR blankets will lead to an appreciable implantation of light particles in structural materials as a consequence of neutron impacts. The influence of implanted helium and lithium on the material properties of CTR structural materials should be known because both media are prospective coolants. 30 keV lithium ions were implanted into prethinned Nb foils. Electron micrographs showed black dots which were identified as precipitates of Li. A concentration profile of He in Nb, which suitably simulates the implantation profile in CTR's, was obtained with the help of the ^{10}B (n,α)^{7}Li reaction. Nb samples which were irradiated up to a He dose of 6×10^{16} cm^{-2} showed heavily damaged surfaces after annealing. Surface erosion of CTR blanket materials due to this process cannot be excluded. (auth)

8493 SEGREGATION OF ALLOYING ELEMENTS TO FREE SURFACES DURING IRRADIATION. Okamoto, P. R.; Wiedersich, H. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 336-345(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Recent transmission electron microscopy examinations of a number of face-centered-cubic and body-centered-cubic metals and alloys irradiated by heavy ions or by high-energy electrons have shown that dynamic interactions of displacement damage with impurities and alloying elements lead to segregation and/or to the formation of second phases at internal surfaces such as voids. To date, the phenomenon has been observed in an experimental 18Cr-8Ni-1Si stainless steel, in commercial 316L stainless steel, in vanadium and in nickel. In the electron irradiated Fe-18 r-8Ni-1Si alloy, analysis of the segregation-induced strain field around the voids indicates that during irradiation minor substitutional alloying elements with negative and positive size factors segregate towards and away from the void surface respectively. Preliminary Auger spectroscopy analysis indicates that a similar segregation phenomenon occurs at the external irradiated surface in nickel-ion bombarded 18Cr-8Ni-1Si stainless steel. These results suggest that undersized substitutional elements may tend to preferentially interchange positions with oversized solutes in interstitial sites, and that transport by interstitials may dominate segregation to defect sinks. (auth)

8494 STUDY OF ^{3}He$^+$-BOMBARDED PALLADIUM USING NUCLEAR MAGNETIC RESONANCE TECHNIQUES. Weaver, H. T.; Beezhold, W. (Sandia Labs., Albuquerque, N. Mex. (USA)). J. Nucl. Mater.; 53: 346-348(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The nuclear magnetic resonance (NMR) from ion-implanted ^{3}He atoms has been observed in ^{3}He$^+$-bombarded palladium. Two 1 μm palladium thin films, one on each side of a copper foil substrate, were bombarded at 75°C with 75 and 140 keV ^{3}He$^+$-ions to a fluence of ~10^{18} ^{3}He$^+$/cm^2 for each energy. Spin-lattice (T_1) and spin-spin (T_2) relaxation times were measured at 10, 20, and 35 MHz in the temperature range 1 – 4 K. The ^{3}He nuclear relaxation data indicate that the implanted atoms after the 75°C bombardment are situated in small clusters within the Pd thin films. (auth)

8495 ANTICIPATED RADIATION DAMAGE PROBLEMS TO LASER OPTICS. Teitel, R. J. (KMS Fusion, Inc., Ann Arbor, Michigan, USA). J. Nucl. Mater.; 53: 349-353(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Surface radiation damage to laser optics is a problem unique to laser-fusion reactor design. Of the radiation sources created by fusion reactions, the optics appear to be most vulnerable to neutron radiation damage. Although no specific designs are available, some general evaluations of anticipated problems will be presented. (auth)

8496 MONTE CARLO TREATMENT OF HEAT FLOW THROUGH A NEUTRAL GAS LAYER. Oliphant, T. A. (Los Alamos Scientific Lab., N. Mex. (USA)). J. Nucl. Mater.; 53: 62-65(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The flow of heat through a neutral gas layer under conditions of density and temperature relevant to the cooling layer used in a reference theta-pinch reactor (RTPR) has been investigated numerically by means of a Monte Carlo technique. The necessity for corrections to the fluid model has been indicated and assessed in an example calculation. (auth)

8497 PHYSICS OF MIRROR REACTORS AND DEVICES. Moir, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). J. Nucl. Mater.; 53: 66-73(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The physics of plasma confinement using the magnetic mirror principle is discussed, and the unique features of the mirror reactor approach to fusion are discussed and compared to the toroidal confinement approach. (auth)

8498 SURFACE REQUIREMENTS OF THE MIRROR EXPERIMENTAL PROGRAM AT LAWRENCE LIVERMORE LABO-

RATORY. Hunt, A. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). J. Nucl. Mater.; 53: 74-75(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The characteristics of the present Mirror Experiments (2XII and BBII) are compared in a table with the characteristics expected in future versions of these experiments which are designated BBII-T and 2XIIB. A list of publications is appended to supply a source for details concerning the associated surface problem. (auth)

8499 SURFACE CONDITIONS IN A CONCEPTUAL D–T MIRROR REACTOR WITH DIRECT CONVERSION. Lee, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). J. Nucl. Mater.; 53: 76-85(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

A conceptual D-T fusion reactor employing magnetic mirror confinement and periodic focusing electrostatic direct conversion is described with emphasis on surface conditions. The major components that make up the conceptual mirror reactor system, namely the injector system, the plasma confinement chamber, and the direct converter must have surfaces capable of intercepting large currents of energetic ions, neutral atoms, neutrons, and photons. The magnitudes of these currents are summarized. The fluxes these surfaces are exposed to will depend to a great degree on what surfaces can handle while having useful lifetimes and low tritium holdup. For the conceptual prototype reactor desired lifetimes are in the 1 to 10 year range and tritium hold-up should be limited to a few hundred grams. Any surface flux that proves to be too high can be reduced by increasing interception area. Surface sputtering, spalling, tritium holdup, and voltage breakdown problems must be examined for the particle types, energies, fluxes, surface materials, conditions, temperatures, and electric field gradients contemplated in mirror reactors. Only when one has such information in hand can interception surfaces be designed. It is emphasized that the surface conditions presented are in most cases crude incomplete estimates based on one conceptual mirror reactor system. While crude, the estimates presented should indicate the magnitude of the surface problems faced in this type of mirror reactor system. As understanding of such systems improves so will estimates of surface conditions. (auth)

8500 DESCRIPTION OF TOKAMAK DISCHARGES IN PRESENT AND FUTURE DEVICES AT PRINCETON PPL. Hinnov, E. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). J. Nucl. Mater.; 53: 9-15(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The evolution in time and space of plasma temperatures and densities in typical discharges of presently operating tokamaks is reviewed. The characteristics of the concomitant bombardment of vaccuum walls and aperture limiters by electrons, ions, neutral atoms, and photons are described together with the behavior of observed impurities of wall and adsorbed materials in the discharge. The influence of the impurities on the plasma properties is discussed, with special consideration for cumulative effects. The discussion is extended to the extrapolated behavior of the discharges in the next generation of tokamaks at PPL. (auth)

8501 PLASMA-WALL INTERACTIONS IN THE TFR MACHINE. Rebut, P. H.; Dei-Cas, R.; Ginot, P.; Girard, J. P.; Huguet, M.; Lecoustey, P.; Moriette, P.; Sledziewski, Z.; Tachon, J.; Torossian, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). J. Nucl. Mater.; 53: 16-24(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Experiments with the tokamak machine, TFR, operating up to 200 kA with 40 kG, have been stopped because the vacuum vessel broke suddenly during a pulse. Three kinds of damages have been observed: heat erosion of the limiter, deposition of eroded materials around the vacuum vessel and regularly spaced impacts on the vacuum vessel. The last phenomenon is new and very severe. Runaway electrons are responsible for the damage of the limiter. The regularly spaced impacts are not yet understood. Several explanations are proposed. (auth)

8502 WALL CONDITIONS IN ORMAK. Colchin, R. J.; Berry, L. A.; Haste, G. R.; Kelley, G. G.; Lyon, J. F.; McNally, J. R.; Murakami, M.; Neidigh, R. V.; Simpkins, J. E.; Wing, W. R. (Oak Ridge National Lab., Tenn. (USA)). J. Nucl. Mater.; 53: 25-30(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

ORMAK is a diffuse toroidal pinch with typical plasma currents of 100 kA, electron temperatures of 800 eV, and ion temperatures of 300 eV. The walls of the plasma region are made of stainless steel coated with an intermediate layer of platinum 0.5 μm thick and an outer 1-2 μm layer of gold. Tests with an Ion Microprobe Mass Analyzer have shown that the platinum acts to decrease diffusion of impurities from the stainless steel to the surface. Gold was chosen to inhibit the surface chemical adsorption of gases. Studies with a movable limiter lead to the belief that electron energy is lost at the plasma edge mainly via line radiation and cooling on ions, while ions are lost from the plasma by charge exchange. Thus the walls are bombarded by energetic neutrals and line radiation. To measure the sputtering rate from these neutrals, a wall sample was coated with 105 Å of radioactive gold and bombarded with neutrals from ORMAK during a day's run. No measurable sputtering was found within the counting statistics of the measurement, but surface carbon contamination of the sample prevents any final conclusions being reached. (auth)

8503 FIRST WALL SURFACE PROBLEMS FOR A D–T TOKAMAK REACTOR. Kulcinski, G. L.; Emmert, G. A. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). J. Nucl. Mater.; 53: 31-38(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The effects of deuterium, tritium, helium and neutron bombardment on surface degradation of the first wall of a 5000 MW_{th} D-T reactor have been analyzed. The effects of both sputtering and blistering have been analyzed and the results applied to 316 stainless steel wall operating at temperatures from 300 to 500°C. It has been calculated that the total wall erosion rate is 0.22 mm/year and that 14 MeV neutron sputtering accounts for two thirds of this number. Sputtering from all neutrons results in ~0.17 mm/year erosion. The calculated erosion rate is 2-3 times that which would be allowable for a 30 year first wall lifetime. (auth)

8504 POLOIDAL DIVERTOR FOR THE WISCONSIN TOKAMAK REACTOR DESIGN. Emmert, G. A.; Donhowe, J. M.; Mense, A. T. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). J. Nucl. Mater.; 53: 39-42(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

A poloidal divertor has been incorporated in the Wisconsin Tokamak Reactor Design (UWMAK-1). Its main features include a double null design using superconducting divertor coils located outside the main toroidal magnets and liquid lithium particle collectors located inside the blanket and shield. (auth)

8505 DIVERTOR OPERATION IN THE PRINCETON REFERENCE DESIGN MODEL TOKAMAK REACTOR. Tenney, F. H. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). J. Nucl. Mater.; 53: 43-47(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

Projected operation of the poloidal field divertor is described for the Princeton Reference Design Tokamak Reactor. A relatively cold plasma blanket will form outside the separatrix and will constitute a thermal connection between the hot plasma and the exhaust chamber. The plasma blanket is expected to be a good absorber of slow neutrals. Simple one-dimensional models of the diverted plasma provide estimates of the plasma density distribution and particle flux to the walls. Recycling of particles with the divertor walls may amount to ten times the particle throughput of the reactor. The magnetic field configuration is also discussed. (auth)

8506 FIRST WALL FLUXES IN A THETA-PINCH FEASIBILITY/D-T EXPERIMENT. Thomassen, K. I.; Oliphant, T. A. (Los Alamos Scientific Lab., N. Mex. (USA)). J. Nucl. Mater.; 53: 48-53(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The first wall of the theta-pinch feasibility and D-T burning experiments is described in terms of its electrical requirements and heat transfer problems. The electrical insulating properties are necessary in order to provide the initial shock heating, while the bremsstrahlung and plasma internal energy deposition put constraints on the mechanical properties and on the choice of materials for the wall. To assess these problems a thermonuclear burn calculation was made to determine the neutron, photon and particle fluxes to the wall. The computer burn code requires the values of the filling pressure and shock heating electric field, then follows the adiabatic compression to ignition and the expansion during the crowbarred phase. Particle densities, temperatures, plasma volume and internal energy, bremsstrahlung flux, neutron flux and fractional burnup are then computed during the burn. Particle flux estimates are obtained from a separate diffusion calculation. A description of the experimental device is given and the detailed results of the above calculations are tabulated. (auth)

8507 SURFACE EFFECTS AT THE FIRST WALL OF THE REFERENCE THETA-PINCH REACTOR (RTPR). Krakowski, R. A.; Clinard, F. W. Jr.; Ribe, F. L. (Los Alamos Scientific Lab., N. Mex. (USA)); Coultas, T. A. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 53: 54-61(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

The fundamental operating principles and parameters inherent to the Reference Theta-Pinch Reactor (RTPR) are described. An emphasis is placed on those engineering aspects of the RTPR design which bear directly on the thermal, hydraulic, and radiation response of the first wall. The major portion of the data presented is calculational, and further experimental and theoretical results are needed to assess accurately anticipated material problems and to forecast appropriate solutions. Material problems envisioned for the RTPR first wall are discussed briefly in the context of the particular RTPR design described. (auth)

8508 CURRENT SHEET MEASUREMENTS IN CUSPED THETA PINCH. Yarborough, W. W. Jr. Nashville; Vanderbilt Univ. (1974). 115p. University Microfilms Order No. 74-22,193.

Thesis (Ph. D.).

The field was produced by discharging a 30.8 μf capacitor bank through two opposing theta pinch coils which were aligned axially. Each of the coils was 7.5 cm in diameter and 12.0 cm in length, and the axial separation between the two was 2.4 cm. The capacitor bank was operated at 10 kV to give a stored energy of 1500 joules and a peak current of 170 kA. The combined coil inductance was 60 nanohenries and the external circuit inductance was 46 nanohenries as determined by the bank to coil voltage ratio and the 11.25 microsecond period. Switching was accomplished via a single National Tube Type NL-1037 ignitron. The device was operated in helium at an initial cold gas pressure of 0.2 torr for an initial particle density of 7.0×10^{15} cm^{-3}. Partial preionization was provided by a 30 kV voltage spike introduced across the ends of the chamber. An inward moving current sheet is formed in each of the theta pinch coils at the beginning of the second cycle of the discharge, the first cycle serving to provide additional heating of the test gas. After confirming the expected symmetries, experimental efforts were concentrated on the current sheet in one of the coils with the assumption that similar results would be found in the other. (Diss. Abstr. Int., B)

8509 REACTIVITY OF CLOSED FUSION REACTOR SYSTEMS FOR ADVANCED FUELS. McNally, J. R. Jr.; Sharp, R. D.; Fowler, R. H.; Clarke, J. F. (Oak Ridge National Lab., TN). Nucl. Fusion; 14: No. 4, 579-581(Sep 1974).

The reactor type treated here is a magnetically closed, pulsed burn system, i.e., it is assumed that there is no fuel feed or unburned plasma or ash loss during the burn. Pseudoclassical diffusion losses are small and are neglected. Charge-exchange losses are small provided $\bar{n}_0 \lesssim 10^6$ H^0/cm^3. The dominant loss is taken to be synchrotron and bremsstrahlung radiations which are relativistically corrected because of the high electron temperatures attained. The reactor properties are taken to be: plasma radius L = 5 m, magnetic field B_0 = 60 kG, and wall reflectivity R = 0.90. Appropriate delta functions in fuel density and temperature are taken for the plasma at t = 0. The particle densities (n_p, n_d, n_t, $n_{^3He}$, n_α, $n_{^6Li}$, $n_{^7Li}$, $n_{^7Be}$) and the Maxwellian temperatures T_i and T_e are then evaluated as a function of time from appropriate time-dependent particle and energy conservation equations. The fusion energy release in charged particles is proportioned to plasma ions and electrons after the method of Rose which assumes Coulomb-dominated processes only. All ions are assumed to equilibrate instantaneously at the same T_i, with the one exception being the fast protons from d(d,p)t and ^{3}He(d,p)α which can induce the exothermic reaction t(p,n)^{3}He. The 14-MeV neutrons from the t(d,n)α-reactions are evaluated in terms of a hypothetical neutron density to evaluate the neutron production and to check nucleon conservation. Slightly different Coulomb logarithms for the energy transfer terms are taken for the plasma ions slowing down on the slower electrons and for the fast electrons slowing down on the plasma ions. (MOW)

8510 ABSORPTION OF AN EXTRAORDINARY ELECTROMAGNETIC WAVE BY THE HALF-SPACE OF MAGNETOACTIVE PLASMA. Klavdiev, V. V. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 8, 1116-1119(1974). (In Russian).

An oblique incidence of an electromagnetic wave on the boundary of the magnetoactive plasma at the diffusive law of particle scattering was considered. The absorption coefficients are calculated for transparent and opaque plasmas. It appeared that in the case of the opaque plasma the absorption coefficient depends on the sign of the incidence angle. (auth)

8511 DYNAMIC LIMITER EXPERIMENTS IN JFT-2 TOKAMAK. Itoh, S.; Sugawara, T.; Suzuki, N.; Takeda, T.; Toi, K. (Japan Atomic Energy Research Inst., Tokai). Nucl. Fusion; 14: No. 4, 581-583(Sep 1974).

The results of the measurement of the effective plasma radius obtained by the plasma-conductivity distribution measurement and the observation of the time variation of light intensity are summarized. It is remarked that the electron temperature at the effective radius is estimated to be 20 to 100 eV from the skin depth of the superposed high-frequency electric field. It is to be seen that the plasma boundary expands together with the dynamic limiter and the radius of the plasma decreases in the later stage of the discharge. The apparent shrinkage of the plasma radius in the later stage is explained by the fact that the plasma ring moves inwards and the peripheral region of the plasma is scraped off by the inner side of the limiter. In deriving the plasma radius from the time variation of light intensity, it is assumed that the light is emitted from the very thin shell near the plasma surface. (MOW)

Wave Phenomena

Refer also to abstracts 8354, 8361, and 8409.

8512 (KHFTI-73-8) GENERATION AND RADIATION OF THE SECOND HARMONIC AT ELECTROMAGNETIC WAVE INCIDENCE ON A SEMIBOUNDED PLASMA. Dolgopolov, V. V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1973. 10p. (In Russian). INIS.

The radiation of the second harmonic of a narrow transition layer from a plasma in vacuum (width of the layer is significantly less than the wavelength) was studied during oblique incidence of the polarized electromagnetic wave on the semibounded plasma. The amplitudes of the wave radiated at double frequency were calculated. The expressions obtained for the field of the second harmonic in the region of the transition layer led to the conclusion that the tangential component of the electric field of the second harmonic undergoes a discontinuity on the plasma boundary. The difference in the results obtained in the present study from corresponding results of earlier published works, where the continuity of the tangential component of the electric field of higher harmonics on the plasma boundary is assumed, is explained. (tr-auth)

8513 SURFACE WAVES IN A MAGNETIZED PLASMA IN A RADIO—FREQUENCY FIELD. Lovetskii, E.E.; Starodub, A.N. (Moscow Engineering—Physics Institute). Sov. Phys.—Tech. Phys. 19: No. 3, 319-322 (Sept 1974).

The effect of an external radio—frequency electric field (rf field) on the surface waves of a magentized plasma is analyzed. A strong rf field can lead to stabilization or to a change in the growth region. The parametric excitation of low—frequency surface waves by an rf field is analyzed. (auth)

8514 ELECTROSTATIC PRECESSION OF ELECTRON LAYERS. PART II: PRECESSION OF FINITE LENGTH E LAYERS. Porter, G.D.; Stallard, B.W. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 17: No. 9, 1722-1726 (Sept 1974).

The precessional stability of un—neutralized, finite—length E layers is examined both theoretically and experimentally. The theoretical analysis assumes the layer is a rigid cylindrical thin shell. Experimental measurements are consistent with the assumption of rigidity. It is shown that in the absence of a toroidal field, an un—neutralized layer is unstable for all amplitudes. This is in contrast with a neutralized layer, which is stable above a critical amplitude. However, the precessional mode is stabilized by the application of a toroidal field. Experimental measurements of the precession frequency show agreement with theory within a factor of two. The discrepancy is attributed to the finite thickness of the layer. (auth)

8515 LINEAR ION ACOUSTIC WAVES IN A DENSITY GRADIENT. Doucet, H.J.; Jones, W.D. (Department of Physics, University of South Florida, Tampa, Florida 33620); Alexeff, I. Phys. Fluids 17: No. 9, 1738-1743 (Sept 1974).

Both the experimental and theoretical behavior of linear ion acoustic waves in density gradients formed in a collisionless discharge plasma have been studied. The experiment and the theory both show a strong spatial growth of the density perturbation produced by the wave when the wave propagates in the direction of increasing density and a damping when the wave propagates in the direction of decreasing density. Theoretically, the growth and damping rates are found to be proportional to $n_0^{1/2}$, where n_0 is the local unperturbed density. By using the measured density profile, good agreement is found between experiment and the linearized fluid theory. Although the wave amplitude n_1, itself, decreases as the wave propagates into a region of lower density, the relative amplitude n_1/n_0 increases. This can be expected to lead to wave steepening and shock–like behavior, as noted previously by others. The work reported here is mainly concerned with the range where the wavelength is smaller than the characteristic length of variation of the plasma density. (auth)

8516 COLLISIONAL EFFECTS ON ION–ACOUSTIC WAVES IN A NONEQUILIBRIUM PLASMA. Huang, T.; Chen, L.; Hasegawa, A. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Fluids 17: No. 9, 1744-1748 (Sept 1974).

For a nonisothermal plasma ($T_e \gg T_i$), there is a range of wavenumbers, $\lambda_e^{-1} < k < \lambda_e^{-1} \epsilon_T^{-3/2}$, such that electrons and ions are weakly and strongly collisional, respectively. Here, λ_e is the electron–ion mean free path and $\epsilon_T = T_i/T_e$. Using a hybrid description, the ion–acoustic dispersion relation corresponding to this wavenumber regime is derived and analyzed. It is found that the dominant collisional effects are due to electron–ion collisions and ion viscosity. The electron–ion collision smears out the wave–particle resonance of slow electrons. Consequently, it reduces the electron Landau damping rate by an order $\epsilon^{1/2}_e$ ($\epsilon_e = 1/k\lambda_e$) and increases the phase velocity by an order $\epsilon^{3/4}_e$. The ion viscosity increases the damping rate by an order $\epsilon^{5/2}_T/\epsilon_e$. (auth)

8517 ABSORPTION OF THE LEFT WAVE NEAR THE ELECTRON CYCLOTRON FREQUENCY. Ferrari, L.A.; McQuade, A.W.; LaHaye, R.J. (Queens College of The City University of New York, Flushing, New York 11367). Phys. Fluids 17: No. 9, 1785-1787 (Sept 1974).

Strong absorption of the left circularly polarized electromagnetic wave near the electron cyclotron frequency is observed. The time at which the absorption begins depends on the peak power of the wave. (auth)

8518 THE BLAST PROBE. AN INEXPENSIVE LASER–BLAST WAVE ENERGY MONITOR. Mayer, F.J. (KMS Fusion, Incorporated, Ann Arbor, Michigan 48106). Appl. Phys. Lett. 25: No. 12, 733-735 (15 Dec 1974).

A simple–to–build and inexpensive Langmuir–probe–type device for determining the time of arrival of a laser–produced blast wave is described. Construction details, typical results, and the method of extracting the blast wave energy are presented. The blast wave energy is shown to be easily determined from the nondimensional form of the blast wave R/t versus R curve. (auth)

8519 DAMPING OF ION–ACOUSTIC WAVES IN A BOUNDED PLASMA. Kondratenko, A.N.; Kuklin, V.M. (A. M. Gor'kii Khar'kov State University). Sov. Phys.–Tech. Phys. 19: No. 3, 326-328 (Sept 1974).

The propagation of surface and volume ion–acoustic waves along the axis of a cylindrical plasma waveguide in a constant magnetic field is considered. The problem is solved in the linear hydrodynamic approximation. The dispersion equations are investigated; phase and group velocities and damping factors for the waves are determined. The damping factors contain a term collisional–dissipative term as a resonance associated with the presence of an inhomogeneous transition layer. It is shown that the properties of volume ion–acoustic waves in an unbounded plasma can be different from those in a waveguide of small radius. (auth)

8520 NONLINEAR PHENOMENA IN PLASMA. Kadomcev, B. Veda Tech. SSSR; 1: No. 3, 41-45(Jun 1973). (In Czech).

A brief description of four cases of nonlinear phenomena in plasma is presented, namely the Landau damping, the echo, the induced scattering of waves, the ion acoustic turbulence. (Nuclear Sci. Abstr. Czech.)

8521 HIGH-FREQUENCY SURFACE WAVE MEASUREMENTS IN A WARM CURRENT PLASMA. Stoychev, T.; Shivarova, A.; Raychev, V. (Sofia Univ. (Bulgaria)). Phys. Lett., A; 49: No. 3, 249-250(9 Sep 1974).

The propagation of axially symmetric high-frequency surface waves along a gas discharge non-isothermal current plasma column, bounded by a dielectric, is investigated. The dispersion and the space damping rate of the downstream and upstream waves are measured and the results are compared with the theory. (auth)

8522 PROPAGATION OF WAVES IN WARM PLASMA WITH ANISOTROPIC PRESSURE. Rawat, S. S. (Government Coll., Kotputli, Jaipur, India). Int. J. Electron.; 37: No. 4, 491-500 (Oct 1974).

The effect of the thermal electron pressure on the propagation characteristics of arbitrarily directed waves travelling in a homogeneous warm electron magneto-plasma is considered. It is noted that, in general, thermal pressure does not affect the propagation characteristics of those waves which are electromagnetic in nature but it excites another wave known as the electron plasma mode. In the case of the isotropic pressure, only one electron plasma mode propagates in all possible directions. But when the thermal electron pressure is considered to be anisotropic, two electron plasma waves propagate in any arbitrary direction other than the directions along and perpendicular to the external magnetic field, in which directions only one electron plasma wave propagates. The phase velocities of these waves are discussed in detail for several particular cases. (auth)

8523 NONLINEAR WAVES OF MAGNETIC SOUND IN THE PLASMA WITH A CHAOTICALLY INHOMOGENEOUS MAGNETIC FIELD. Tamoikin, V. V.; Fainshtein, S. M. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 8, 1120-1125(1974). (In Russian).

The propagation of a nonlinear magneto acoustic wave in plasma with a constant magnetic field fluctuating in magnitude and direction was investigated. It is shown that the magnetic field averaged over the inhomogeneity ensemble attenuates, the attenuation is of low-frequency character. The generalized Korteweg–de Vries equation is obtained. The estimates of the soliton amplitude damping in the earth magnetosphere are given. (auth)

ENGINEERING

Energy Conversion

8524 OPTIMUM DIMENSIONS OF A COAXIAL THERMIONIC CONVERTER. Sinyavskii, V.V. Sov. Phys.—Tech. Phys. 19: No. 3, 373-377 (Sept 1974).

The condition for the maximum specific energy is used to obtain simple expressions for the optimum values of the relative length, diameter, and thickness of the emitter shell, of the collector, and of the collector insulation in a coaxial thermionic converter. The optimum values are given in terms of functional dependences on the appropriate similitude criteria. The results calculated from these equations agree with the results of the many—parameter optimization. (auth)

8525 SURFACE REQUIREMENTS FOR ELECTROSTATIC DIRECT ENERGY CONVERTERS. Moir, R. W.; Barr, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.); Miley, G. H. (Illinois Univ., Urbana (USA)). J. Nucl. Mater.; 53: 86-96(Sep 1974).

From conference on surface effects in controlled thermonuclear fusion devices and reactors; Argonne, Illinois, USA (10 Jan 1974).

There are two major electrostatic direct energy converter concepts which will be discussed from the point of view of the surfaces. One is the Venetian blind concept and the other is the periodic electrostatic focusing concept. They are both of the direct collector type. Fluxes of D^+, T^+, He^{++}, electrons, and X-rays are given. Design considerations due to thermionic emission, secondary electron emission, and radiation cooling are discussed. A detailed discussion is devoted to breakdown physics, the voltages and electric field strengths that can be employed, and how surface deterioration may affect voltage holding due to He^{++} bombardment blistering. (auth)

Facilities and Equipment

Refer also to abstracts 8169, 8171, 8320, 8321, 8631, 10317, and 10370.

8526 (CEA-CONF-2673) USE OF A SORPTION TRAP FOR THE HELIUM TIGHTNESS CONTROL OF LARGE-VOLUME VESSELS. Chalon, H.; Tronel, L. (CEA Centre de Pierrelatte, 26 (France)). 1974. 7p. (In French). (CONF-740679-1). Dep. NTIS (US Sales Only) $4.00.

From meeting on vacuum technology: cryogenic vacuum; Versailles, France (10 Jun 1974).

Tightness control and the locating of leaks by using He as a gas tracer are well-known techniques. The technique has been improved and made less costly by the use of sorption traps. The leak control installation consists of a mass spectrometer leveled on H, a sorption trap cooled with liquid N_2, a set of pumps for tests on volumes larger than 10 m^3, and a set of pumps for volumes smaller than m^3. Expressions describing the operation of the system are derived. The system is described and tightness tests on volumes of 5 and 150 m^3 are reported. The advantages of using a sorption trap are cited. (JSR)

8527 IMPROVEMENTS IN OR RELATING TO TUBE-IN-SHELL HEAT EXCHANGERS. Linning, D. L. (To United Kingdom Atomic Energy Authority). British Patent 1,360,239. 17 Jul 1974. 3p.

A "tube-in-shell" heat exchanger is described comprising a cluster of heat-exchanger tubes arranged in parallel rows and connected to a tube plate at each end. The cluster is enclosed in a shell and thermal insulation for the tube plates faces within the shell. The insulation takes the form of a series of plates arranged edge on to the tube plates, and parallel to one another, between successive rows of tubes. The plate members are freely supported at their ends from a flanged ring secured to the face of the tube plate and encircling the cluster of heat exchange tubes. The plate members may be spaced from the faces of the tube plates, and may be planar or convolute in form. Such heat exchangers are suitable for sodium/water circuits, and are cheaper to manufacture than those employing drilled baffle plates; they also avoid the risk of local tube failure due to excessive pressure build up following transient changes in operating conditions. The degree of thermal insulation achieved depends on the depth of the plate members; the insulation is also relatively easy to assemble. (UK)

8528 THE FREE VIBRATIONS OF CYLINDRICAL SHELLS WITH VARIOUS END CLOSURES. Galletly, G. D.; Mistry, J. (Liverpool Univ. (UK). Dept. of Mechanical Engineering). Nucl. Eng. Des.; 30: No. 2, 249-268(1974).

The natural frequencies of vibration of cylindrical shells clamped at one end and closed at the other by different types of shells of revolution (cones, hemispheres, ellipsoids, etc.) were determined using programs written for the digital computer. The principal numerical methods investigated were variational finite-differences and finite elements. However, some results obtained by numerical integration of the differential equations of motion, together with some obtained from series solutions, are also given for purposes of comparison. For $L/D = 0.5$, $h/D = 0.01$ the lowest four natural frequencies for all the cylinder/end closures investigated were concentrated in a band such that $\Omega_4/\Omega_1 \simeq 1.7$. Thus, changing the head shape does not cause radical changes in the natural frequencies for these geometric ratios. Results for other values of the geometric parameters are also given in the paper. Again for $L/D = 0.5$, $h/D = 0.01$, the effect of not equating to zero the in-plane circumferential displacement at the base of the cylinder caused a marked reduction in the $n = 1$ natural frequencies. In many of the cases studied, the $n = 1$ frequency was either the fundamental one or was close to it. Insofar as dynamic analyses are concerned, designers ought to be aware of the influence that the in-plane boundary conditions at the cylinder base can have on the natural frequencies. With regard to the main two numerical methods studied, it was found that both of them are effective for the natural frequency and mode shape predictions. For pointed shells (e.g., cones) it appears that for $n = 0$ and $n = 1$, the conditions employed at the apex in some of the programs need re-examination. (auth)

8529 STRESS WAVES IN ELASTIC RODS INDUCED BY RADIATION HEATING. Bargmann, H. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Eng. Des.; 30: No. 2, 234-241(1974).

Consider a stress-free, thin, elastic rod, freely suspended. At time $t = 0$, the rod is rapidly exposed to a high temperature field inside, uniform over the cross-section $T(x,t)$, $t \geq 0$. Such a case arises in an external target when bombarded with a fast extracted proton beam of high energy and high intensity. In contrast to the quasi-static solution $\sigma_x \equiv 0$, stress waves are created at both free end-faces, at time $t = 0$, which propagate into the rod. Closed-form solutions are presented for a fast rise of a homogeneous temperature, during rise time t_0 to the final value T_0. Maximum compressive and tensile stresses will occur which may easily lead to failure of the rod. In particular, for an extremely fast rise $t_0 < t_m$, t_m being the characteristic mechanical time, $|\sigma_x|_{max} = E\alpha T_0$, which is the absolute value of a compressive stress in a rod fixed at the ends. For $t_0 > t_m$, $|\sigma_x|_{max} = E\alpha T_0 t_m/t_0$, i.e., the maximum stresses are proportional to the length of the rod and inversely proportional to the rise time. (auth)

8530 VIBRATIONS OF TWO COAXIAL CYLINDRICAL SHELLS CONTAINING FLUID. Krajcinovic, D. (Illinois Univ., Chicago (USA)). Nucl. Eng. Des.; 30: No. 2, 242-248(1974).

The vibrational behavior of two long, elastic, coaxial cylindrical shells containing (or conveying) fluids is considered. Both exact and approximate formulas for the added (attached, virtual) mass of the fluid are derived. The method of analysis is illustrated using appropriate shell equations. (auth)

8531 A GENERAL STUDY OF TORNADO-GENERATED MISSILES. Lee, A. J. H. (Gilbert Associates, Inc., Reading, Pa. (USA)). Nucl. Eng. Des.; 30: No. 3, 418-433(1974).

A rational procedure for calculating the velocity of tornado-generated missiles is presented. The procedure includes the setup of a simplified three-dimensional tornado wind model, a mechanism for the missile to be injected into, and sustained in, the wind field, as well as the description of missile acceleration in the wind field, based on the centrifugal force consideration. The maximum elevation which a missile can reach is also investigated. Throughout the study conservative and yet consistent assumptions are made for the orientations and aerodynamic characteristics of the missile. (auth)

8532 SWING-R—A COMPUTER CODE TO CALCULATE THE TIME HISTORY OF MULTI-MASS SYSTEMS WITH CONSIDERATION OF NON-LINEARITIES OR DRY FRICTION. Oesterle, B. (Technische Univ. Muenchen, Garching (F.R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Nucl. Eng. Des.; 30: No. 3, 379-388(1974).

The computer code SWING-R calculates the time history of the positions, velocities and accelerations of multi-mass systems with up to ten degrees of freedom. In addition to the well-known linear mechanical system $[M]\{\ddot{\chi}\} + [C]\{\dot{\chi}\} + [K]\{\chi\} = \{f(t)\}$, non-linearities or dry friction can be considered. The calculation of the frictional process includes the transition from static to kinetic friction and vice versa. The matrix exponential method was used for integrating the matrix differential equation of motion. (auth)

8533 PLASTIC SHALLOW SHELLS UNDER COMBINED LOADS. Sherbourne, A. N.; Haydl, H. M. (Waterloo Univ., Ontario (Canada)). Nucl. Eng. Des.; 30: No. 3, 389-401(1974).

Details of an experimental program, concerned with shallow spherical shells under combined lateral and inplane pressure loading, are described. The available theoretical analyses are reviewed and their predictions are compared to the experimentally obtained results. Yield point and post-yield behavior of the shells is discussed and some recommendations regarding the analysis and design of these shells are made. (auth)

8534 NONLINEAR VIBRATIONS OF ELASTICALLY RESTRAINED RECTANGULAR ORTHOTROPIC PLATES. Ramachandran, J. (Indian Inst. of Tech., Madras). Nucl. Eng. Des.; 30: No. 3, 402-407(1974).

The influence of large amplitudes on the flexural vibrations of elastically restrained rectangular orthotropic plates is considered. The basic equations used are those due to Von Karman. Galerkin's averaging technique is used to reduce the original equation to an ordinary nonlinear differential equation in modal function, the solution of which is given in terms of elliptic functions. (auth)

8535 A HIGH PRECISION TRIANGULAR PLATE BENDING ELEMENT FOR THE ANALYSIS OF THICK PLATES. Venkateswara Rao, G.; Venkataramana, J.; Raju, I. S. (Structural Engineering Division, Space Science and Technology Centre, Trivandrum, India). Nucl. Eng. Des.; 30: No. 3, 408-412(1974).

A high precision triangular plate bending element for the analysis of thick plates is developed. The element has three nodes and 12 degrees of freedom per node. Explicit expressions for stiffness coefficients are derived. The superiority of the element is demonstrated by the accuracy of the results obtained by applying it to some typical thick plate problems. (auth)

8536 THERMAL ANALYSIS OF PLATES WITH CIRCULAR INCLUSIONS. McFall, A. L.; Ariman, T.; Lee, L. H. N. (Notre Dame Univ., Ind. (USA)). Nucl. Eng. Des.; 30: No. 3, 339-348 (1974).

A least square boundary point matching method is employed to determine the temperature distributions and deformations of rectangular plates with circular elastic inclusions. Solutions for two problems have been obtained. The first problem is concerned with the determination of the temperature distribution in a finite rectangular plate having a circular inclusion and subjected to prescribed temperature distribution and thermal conditions along the edges. The plate is heated uniformly through the thickness. The second problem is concerned with the deflection and moment distribution in the same plate model with simply supported edges and prescribed temperature variation across the thickness but no temperature variation over the plate surface. Numerical results are presented. (auth)

8537 PERIODIC EXCITATION OF A FINITE LINEAR VISCOELASTIC SOLID. Langhaar, H. L.; Boresi, A. P.; Miller, R. E. (Illinois Univ., Urbana (USA). Dept. of Theoretical and Applied Mechanics). Nucl. Eng. Des.; 30: No. 3, 349-368(1974).

The response of a finite three-dimensional standard linear viscoelastic solid to periodic excitation is investigated. The theory is specialized for a circular cylindrical body that is bonded to a rigid base at one end and shaken by a prescribed oscillation of a circular rigid plate that is bonded concentrically to the other end. A practical relevance of the theory is the design of vibration absorbers that are made of blocks of viscoelastic materials. Four types of motion of the driving plate are treated: (1) a simple harmonic translation of the plate perpendicular to its plane; (2) an angular oscillation of the plate about its normal axis of symmetry; (3) a simple harmonic translation of the plate in its plane; and (4) an angular oscillation of the plate about a diameter. The theory provides the displacements, stresses, and natural frequencies of the body for the four types of motion. In addition, the mean power input and driving force or driving moment applied to the plate are obtained. Computer programs have been written for the solutions of finite difference approximations of the governing equations. Sample results of the computations are included. (auth)

8538 ANALYSIS OF VISCOPLASTIC EFFECTS IN PRESSURE VESSELS BY THE FINITE ELEMENT METHOD. Zienkiewicz, O. C.; Owen, D. R. J. (University Coll. of Swansea (UK)); Cormeau, I. C. (Brussels Univ. (Belgium)). Nucl. Eng. Des.; 28: No. 2, 278-288(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

In this paper it is shown how the finite element technique can be employed in the solution of elastic-viscoplastic problems. By attaining steady-state conditions the process offers an alternative method of solution for elasto-plastic situations. The solution algorithm employed is relatively simple and possesses many advantages over the conventional computational procedures utilized in elasto-plastic material analysis. Strain-softening materials present no difficulty and it is indicated how viscoelastic-plastic situations could also be analyzed. Several examples of interest to pressure vessel technology are presented and in particular the pressure loading of a spherical pressure vessel containing a flush nozzle junction is considered. (auth)

8539 ELASTIC-PLASTIC CREEP ANALYSIS OF HIGH TEMPERATURE NUCLEAR REACTOR COMPONENTS. Zudans, Z.; Reddi, M. M.; Fishman, H. M.; Tsai, H. C. (Franklin Inst. Research Labs., Philadelphia, Pa. (USA)). Nucl. Eng. Des.; 28: No. 3, 414-445(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

A method for solving the problem of non-isothermal elastic-plastic creep structures is presented. Finite element discretization is utilized, based on a number of flat and curved, thick and thin shell elements of triangular and quadrilateral form. Material nonlinearities are treated by the tangent stiffness method; geometric nonlinearities are considered by updating the geometry after each loading increment. Non-isothermal loading is considered by making a transition to the new temperature at the beginning of the load step and allowing the solution to settle at the position of overall equilibrium by iterative steps. (auth)

Lasers

8540 (AD-775656) FREQUENCY TUNED CO_2 LASER. Interim Technical Report, 1 October—31 December 1973. Abrams, R. L. (Hughes Research Labs., Malibu, Calif. (USA)). Mar 1974. Contract N00014-73-C-0324. 58p. NTIS $3.75.

The program represents an effort to develop a stable, tunable CO_2 laser with a tuning range of plus or minus 750 MHz. In order to increase the tuning range of a CO_2 laser beyond the 50 to 100 MHz Doppler broadening limited value, it is necessary to increase the gain linewidth. The technical approach taken is to raise the operating laser pressure and thus broaden the gain linewidth. The linewidth broadens at the rate of 5.3 MHz/torr and equals 1500 MHz at 283 torr. High pressure operation is achieved by operating the laser in the waveguide mode, and thus using a small capillary bore as the gas discharge region. (auth)

8541 (AD-775746) ND:YAG MINI-FACE-PUMPED LASER (FPL). Final Report, June 1971—May 1973. Chernoch, J. P.; Jones, W. B. (General Electric Co., Schenectady, N. Y. (USA)). Dec 1973. Contract F33615-71-C-1761. 81p. (SRD-73-137; AFAL-TR-73-446). NTIS $4.00.

The purpose of this program was to demonstrate the feasibility of extending the mini-face-pumped laser (FPL) concept to use Nd:YAG as the laser material. The program is divided into 2 parts: the experimental investigation of Nd:YAG mini-FPL pump cavities, and the theoretical study of the possible application of the mini-FPL concept to the low power, high efficiency mode of operation required for space communications. Design parameters were generated which are necessary for the construction of YAG mini-FPL's with specific performances. (GRA)

8542 (AD-776063) WAVEGUIDE GAS LASERS. Final Report, 1 November 1972—30 November 1973. Abrams, R. (Hughes Research Labs., Malibu, Calif. (USA)). Dec 1973. Contract F19628-73-C-0086. 63p. NTIS $6.25.

The program is an exploratory study on waveguide gas lasers in general, with an emphasis on waveguide CO_2 lasers. The goals of the program were to investigate the operating parameters of waveguide gas lasers, to demonstrate single mode operation of a CO_2 waveguide laser over the pressure broadened linewidth, to mode lock the CO_2 waveguide laser, and to study mode control of waveguide lasers. Experiments on frequency tuning of the waveguide CO_2 laser were performed. An extensive theoretical treatment has been performed on resonators for waveguide lasers. Using a matrix diagonalization technique, the resonator losses and resonator modes for waveguide resonators have been determined. Specific resonator configurations were found which are specifically designed for high transverse mode selectivity. (GRA)

8543 (AD-776072) BIBLIOGRAPHY OF SOVIET LASER DEVELOPMENTS. Number 13, July—September 1973. Hibben, S. G. (Informatics, Inc., Rockville, Md. (USA)). 23 Jan 1974. 157p. (AFOSR-TR-74-0357). NTIS $11.00.

This is the Soviet Laser Bibliography for the third quarter of 1973 and is No. 13 in the series on Soviet Laser Developments. The coverage includes basic research on solid state, liquid, and gas lasers; chemical lasers; theoretical aspects of advanced lasers; components; nonlinear optics, spectroscopy of laser materials; ultrashort pulse generation; crystal growing; and general laser theory. Laser applications are listed under biological effects; communications; computer technology; holography; instrumentation and measurements; beam-target interaction; and plasma generation and diagnostics. (auth)

8544 (AD-776173) PLASMA BEAM CO_2 LASER. Zaroslov, D. Yu.; Karlova, E. K.; Karlov, N. V.; Kuzmin, G. P.; Prokhorov, A. M. Translated by J. F. Eros from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 665-668(1972). 7p. NTIS $3.00.

The article discusses excitation, produced for the first time by a plasmotron, of a CO_2 laser, achieved by the injection of plasma beams formed in capillary plasmotrons into the operating volume of the laser. (GRA)

8545 (AD-776267) FEASIBILITY OF PRODUCING STIMULATED EMISSION IN THE 3 TO 5 WAVELENGTH BAND BY EXCITING HYDROGEN CHLORIDE VIBRATIONAL LEVELS. Shirley, J. A.; Hall, R. J.; Bronfin, B. R. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 30 Nov 1973. Contract N00014-72-C-0450. 25p. NTIS $4.25.

The feasibility of producing stimulated emission in the 3 to 5 wavelength band by exciting hydrogen chloride vibrational levels by electron impact is being investigated theoretically and experimentally. Theoretical predictions of electrically pulsed HCl laser performance indicate that gain coefficient in excess of 1%/cm and optical efficiencies in the 20 to 30% range should be realizable in the present experiment. The pulsed HCl laser experiments in progress are described. (auth)

8546 (AD-778066) STUDIES ON PASSIVE Q-SWITCH MATERIALS FOR LASERS. Final Report, 15 December 1972. Margerum, J. D.; Wong, S. Y.; Lackner, A. M.; Little, M. J.; Spaeth, M. L. (Hughes Research Labs., Malibu, Calif. (USA)). Jun 1973. Contract F33615-61-C-1171. 207p. (AFML-TR-106). NTIS $5.75.

The behavior of passive O-switch (POS) materials and the mechanisms responsible for fatigue were investigated for the purpose of achieving improved passive O-switch materials for lasers. The research program emphasized basic chemical materials aspects of POS dye solutions and their improvements. The investigation combined fundamental and applied research related to the use of materials as reliable and efficient passive O-switches for ruby lasers. The work included the synthesis of dyes and studies of the photochemical fatigue processes as well as the optical saturation processes. Emphasis was placed on the improvement of POS materials that can also act as mode-locking components. For this reason most of the work was done on polymethine-type of dye structures. (GRA)

8547 (AD-778848) CUMULATIVE AUTHOR INDEX FOR SOVIET LASER BIBLIOGRAPHIES, NOS. 1–12, JANUARY 1969–JUNE 1973. Hibben, S. G. (Informatics, Inc., Rockville, Md. (USA)). 1 Apr 1974. Contract F44620-72-C-0053. 90p. (AFOSR-TR-74-0748). NTIS $4.00.

This is a cumulative author index of all authors who have appeared in the Bibliographies of Soviet Laser Developments, Numbers 1-12, January 1969–June 1973. (auth)

8548 (AD-779261) ARPA–NRL–LASER PROGRAM. Semiannual Technical Report, 1 January–30 June 1973. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 59p. (NRL-MR-2767). NTIS $3.75.

The ARPA–NRL high-energy laser program is concerned with the development of laser technology in four program areas; chemical lasers, electric discharge lasers; high power glass lasers, and new laser techniques. (GRA)

8549 (AD-779266) ANALYSES OF X-RAY LASER APPROACHES. 1. Extension of 3P Yield 3S Ion Lasers into the Vacuum–uv Region. Elton, R. C. (Naval Research Lab., Washington, D. C. (USA)). May 1974. 18p. (NRL-MR-2799). NTIS $3.00.

The feasibility of extending existing near-ultraviolet ion lasers into the vacuum-ultraviolet spectral region is analyzed with a simple three-level model. Single-pass amplification in a laser-produced plasma of reasonable length is predicted, especially for high electron temperatures. The results are intended to serve as a basis and incentive for further more complete numerical modeling and for experiments. (auth)

8550 (AD-779470) STUDY OF ULTRAVIOLET LASERS. Final Report, 4 February 1972–28 February 1974. Wallace, S. C.; Hodgson, R. T.; Dreyfus, R. W. (IBM Watson Research Center, Yorktown Heights, N. Y. (USA)). 1974. Contract DAHC04-72-C-0017. 12p. (AROD-10437.10-P). NTIS $3.00.

Recent work is reported on problems of producing vacuum ultraviolet lasers. Problems of producing yet shorter wavelengths, of tuning the output, and of raising the efficiency, are discussed. (GRA)

8551 (AD-779759) EFFECTS OF GASEOUS CONTAMINANTS ON GAS DYNAMIC LASER PERFORMANCE. Tennant, R.; Vargas, R.; Hadley, S. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). 1974. 7p. (CONF-740114-3; AFWL-TR-74-505). NTIS $4.00.

From 12th aerospace sciences meeting; Washington, District of Columbia, USA (30 Jan 1974).

A shock tube driven gasdynamic laser is being used to study the effect of gaseous contaminants upon laser performance. The performance is being evaluated in terms of the small signal gain measured at 10.6 micrometers (P (18) transition). Contaminants being studied include sulfur dioxide, carbon monoxide, and hydrogen chloride. Comparisons of measured and calculated values of small signal gain have been made for cases where adequate kinetic rate data was available. Allowable levels of these contaminants and their implications are discussed. (auth)

8552 (AD-779838) TOWARDS SHORTER WAVELENGTH LASERS AND BREAKING THE 1000 A BARRIER I (ELECTRON AND PHOTON PUMPING). Ali, A. W. (Naval Research Lab., Washington, D. C. (USA)). May 1974. 40p. (NRL-MR-2792). NTIS $3.25.

Electron and proton pumping as excitation mechanisms for vacuum ultraviolet (vuv) and x-ray lasers are discussed. Criteria are developed and quantitative estimates of the required pump powers are given. The necessary tools for model calculations are presented and some possible short wave laser sources are pointed out. (auth)

8553 (AD-779940) BIBLIOGRAPHY OF SOVIET LASER DEVELOPMENTS. Number 14, October–December 1973. Hibben, S. G. (Informatics, Inc., Rockville, Md. (USA)). 30 Apr 1974. 123p. (AFOSR-TR-74-0796). NTIS $4.50.

This is the Soviet Laser Bibliography for the fourth quarter of 1973 and is No. 14 in the series on Soviet Laser Developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; crystal growing; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; computer technology; holography; laser-induced chemical reactions; instrumentation and measurements; beam-target interaction; and plasma generation and diagnostics. (auth)

8554 (PB-775794) REVIEW OF TRANSVERSE AND AXIAL LASER MODES. Kruger, J. S. (Harry Diamond Labs., Washington, D. C. (USA)). Jul 1973. 19p. NTIS $3.00.

The resonant cavity is the prime factor affecting a laser's mode structure. Within the cavity, two types of oscillation can occur–transverse and axial. The axial modes directly affect the degree of monochromaticity, whereas the transverse modes principally affect the beam divergence, spot size, and maximum power density. Both types of modes are considered. The relationship of resonant frequencies of the laser cavity to axial and transverse modes is explained. (auth)

8555 (UCID-16168) FLOWING DYE CELL IN A MODE-LOCKED Nd^{+3} YAG OSCILLATOR. Pierce, E. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Sep 1972. Contract W-7405-eng-48. 7p. Dep. NTIS $4.00.

Using a flowing dye cell improves the repeatability of pulse trains and the uniformity of output energy in a passively mode-locked yttrium-aluminum garnet (YAG) laser. Spatial quality is also improved indirectly at the same time. (auth)

8556 (UCID-16174) TWO-FREQUENCY ARGON LASER FOR DIFFERENTIAL DOPPLER VELOCITY MEASUREMENTS. Long, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Oct 1974. Contract W-7405-eng-48. 8p. Dep. NTIS $4.00.

A technique is described that would allow the measurement of the velocity of moving reflectors to accuracies on the order of 0.5%. The technique utilizes a laser operating at two frequencies simultaneously. A reflected signal is Doppler shifted and compared with a reference signal to make the measurement that determines the velocity of a moving object. If this technique is further developed, it may provide accurate, time-resolved, Doppler–velocity measurements of moving objects. (auth)

8557 CONSTRUCTION AND SOME POTENTIAL APPLICATIONS OF ELECTRON–BEAM–EXCITED SEMICONDUCTOR LASERS (review). Bogdankevich, O.V. Sov. J. Quantum Electron. 3: No. 6, 455-463 (May 1974).

The construction of electron–beam–excited semiconductor lasers, their present characteristics, and electron–optics requirements are discussed. The characteristics of laboratory prototypes and of sealed commercially produced laser tubes are given. Potential applications of these lasers in information transmission systems, projection television, metrology, and spectroscopy are reviewed. (auth)

8558 OPTIMIZATION OF THE GEOMETRICAL DIMENSIONS OF THE COLD CATHODE OF A HELIUM–NEON LASER. Martynov, V.F.; Ryazantseva, E.N. Sov. J. Quantum Electron. 3: No. 6, 478-480 (May 1974).

An investigation was made of the depth of penetration of a gas discharge into the cavity of a cylindrical cold cathode. This depth was determined as a function of the discharge current (from 5 to 100 mA), the pressure (from 0.62 to 5mm Hg), and the ratio of the partial pressures of helium and neon (4:1, 6:1, 8:1, 10:1, 12:1). A mixture with the 6:1 ratio was used as an example to demonstrate the method for deriving the empirical dependence of the depth of penetration of the discharge on the factors listed above. The results of life tests indicated that a correct selection of the cathode geometry increased considerably the service life. (auth)

8559 QUASICONTINUOUS EMISSION FROM ION LASERS IN ELECTRODELESS HIGH–FREQUENCY DISCHARGES. Akirtava, O.S.; Bogus, A.M.; Dzhikiya, V.L.; Oleinik, Y.M. Sov. J. Quantum Electron. 3: No. 6, 519-520 (May 1974).

The generation conditions were investigated and the output characteristics were determined for the blue–green laser radiation emitted by xenon ions and for the ultraviolet radiation by oxygen ions. These ions were excited in an electrodeless high–frequency discharge using excitation pulses of ~1.5 msec duration. The total pulse output power of the xenon ions was ~120 W under quasicontinuous conditions and the corresponding output power of the O II ($\lambda = 374.95$ nm) and O III ($\lambda = 375.98$ and 375.48 nm) oxygen lines was 5 W. It was found that these lines could be emitted continuously. (auth)

8560 MODE-LOCKING OF LASERS. Smith, P. W.; Duguay, M. A.; Ippen, E. P. Progress in Quantum Electronics, Volume 3, Part 2. Elmsford, NY; Pergamon Press, Inc. (1974). 126p. $10.00.

A historical review is given of laser mode-locking that has been reported from the first papers in 1964 to the present time. The different types and techniques of mode locking are described. The mode-locking of some specific laser systems is also discussed. (455 references) (MOW)

8561 CONTINUOUS CO_2 LASERS. Wilson, J. (Institut de Mecanique des Fluides, Marseille). Energ. Nucl. (Milan); 21: No. 10, 570-582(Oct 1974).

The technical development of steady state lasers is summarized. The discharge conditions for a conventional discharge are examined to determine the factors leading to high efficiency. The limitation on total power output is shown to be diffusion, which leads to the convection cooled laser to overcome this limitation. For high pressure operation, separation of the means of ionization and excitation in the discharge is advantageous, giving rise to electron-beam controlled discharge lasers. Convection itself can be used as a mechanism for producing an inversion, as in the gasdynamic laser, which is the highest power continuous laser. Limitations on gasdynamic laser efficiency are discussed. (auth)

8562 LASER SYSTEM. Naiman, C. S.; Chicklis, E. P.; Linz, A. (to Sanders Associates, Inc.). US Patent 3,833,805. 3 Sep 1974. Filed Date 1 May 1972. 4p.

A room temperature optically pumped solid state laser operating in the 0.8 to 0.9 micron region with inherently low beam divergence enhances covert laser systems because of compatibility with high quantum efficiency low noise photocathodes. (Official Gazette)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 9311 and 9953.

8563 (AD-779893) AMPLIFICATION BY INJECTION LOCKING OF A JOSEPHSON OSCILLATOR. Stancampiano, C. V.; Shapiro, S. (American Museum of Natural History, New York). Apr 1974. Contract N00014-67-A-0398-0003. 18p. NTIS $3.00.

Josephson oscillations near 9 GHz, produced by a point-contact junction mounted in a coaxial resonator and biased onto the cavity-induced step in its V-I curve have been pulled in frequency and phase locked by a weak injected signal at a nearby frequency. The resulting output was at the signal frequency and had the narrow bandwidth and frequency stability of the input but the power level of the Josephson oscillations. Maximum gain of 51 db was achieved for an input of 10^{-16} W. (auth)

8564 (AD-780225) SUPERCONDUCTING ELF MAGNETIC FIELD SENSORS FOR SUBMARINE COMMUNICATIONS. Wolf, S. A.; Nisenoff, M.; Davis, J. R. (Naval Research Lab., Washington, D. C. (USA)). 9 May 1974. 15p. (NRL-7720). NTIS $3.00.

The ferromagnetic-core solenoid used as a trailed antenna for communications reception by submarines has not demonstrated adequate sensitivity to satisfy the performance requirements of deeply submerged submarines receiving elf transmissions from the planned Sanguine communications system. It is possible, however, that a superconducting quantum interference device (SQUID) can be adapted to this role and satisfy all requirements of platform depth, speed and maneuverability. The report describes the current status of SQUIDS and presents some laboratory measurements that prove the potential of these devices for elf communications reception. It also discusses the engineering development that must be pursued in the areas of (A) sensor and electronics dynamic range, (b) sensor orthogonality, and (c) refrigeration systems to make SQUID elf sensors available as operational receiving antennas. (auth)

8565 (BMFT-FB-T-73-03) MATERIALS FOR SUPERCONDUCTING AC MAGNETS WITH RISETIME OF THE MAGNETIC FIELD IN THE RANGE OF 1 SECOND. Hillmann, H. (Bundesministerium fuer Forschung und Technologie, Bonn (F.R. Germany); Zentralstelle fuer Luft- und Raumfahrtdokumentation und -information, Muenchen (F.R. Germany)). Apr 1973. 81p. (In German).

Based on extensive work on superconductors in dc-magnets, further work was done with superconductors for use in pulsed magnets with risetime of the magnetic field in the range of 1 second. It was found important to integrate results of different fields of physical, metallurgical and technological kinds. The development work concerned composites of NbTi-base alloys with copper substrate, copper–nickel substrate and mixed substrate with filament numbers up to 1,200 and filament-diameters down to approximately 10 μm. Electrical and mechanical properties of the materials and composites were investigated and current densities in superconductors up to 2.6×10^5 A/cm^2 were reached. (auth)

8566 (BNL-19260) AC LOSSES OF Nb_3Sn. BUSSIERE: J. F.; Garber, M.; Suenaga, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 30 Sep 1974. 4p. (CONF-740957-6). Dep. NTIS $4.00.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

60 Hz losses were measured at 4.2°K in a number of Nb_3Sn rods and tapes produced by the bronze-diffusion process and in commercial Nb_3Sn tapes. At low fields ($\lesssim$900 Oe), losses vary by more than two orders of magnitude among the different samples and are related to surface topography. At high fields ($\gtrsim$20 kOe) the variation among samples is much less, and depends mainly on the bulk critical current density J_c. The losses are analyzed quantitatively in terms of the critical state model, including a surface current. (auth)

8567 (BNL-19261) AC CRITICAL CURRENTS OF COMMERCIAL Nb_3Sn TAPES. Garber, M.; Shen, S.; Bussiere, J.; Morgan, G. (Brookhaven National Lab., Upton, N. Y. (USA)). 30 Sep 1974. 4p. (CONF-740957-9). Dep. NTIS $4.00.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

Quench currents and critical currents have been measured for a number of commercial Nb_3Sn tapes at 4.2°K. The measurements were made at 60 Hz. The observed quench currents in the as-received tapes are considerably lower than the critical currents, which can be determined by a new technique after stabilizing material is added. The temperature dependence over the entire range above 4.2°K was measured for two of the samples. The critical current falls off approximately as $1-(T/T_c)^2$. (auth)

8568 (BNL-19269) ANALYTICAL STUDY OF CURRENT-SHARING AT POWER FREQUENCY BETWEEN A TYPE II SUPERCONDUCTING COMPOSITE WITH A NORMAL METAL BACKING. Morgan, G. (Brookhaven National Lab., Upton, N.Y. (USA)). 30 Sep 1974. 8p. (CONF-740957-17). Dep. NTIS $4.00.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

Current sharing in a two-layer composite is studied analytically by numerically solving the 1-dimensional diffusion equation in the normal metal and the phenomenological critical state model with field independent critical current density J_c (T) in the superconductor, with boundary conditions appropriate to a transmission line at each surface and the interface. It is found that with a sufficiently low resistivity (ρ) backing, and reasonable assumptions as to heat transfer, an appreciable fraction of a current density of several thousand amps per cm can be carried in the backing with the balance in a superconductor with high T_c such as Nb_3Sn. The dependence of the dissipation on such parameters as thickness, J_c, ρ and frequency at constant temperature is given, and typical loss voltage waveforms presented. (auth)

8569 JOSEPHSON TUNNELING THROUGH LOCALLY THINNED SILICON WAFERS. Huang, C.L.; Van Duzer, T. (Department of Electrical Engineering and Computer Sciences, and the Electronics Research Laboratory, University of California, Berkeley, California 94720). Appl. Phys. Lett. 25: No. 12, 753-756 (15 Dec 1974).

We have made and tested Josephson junctions in which tunneling takes place through a locally thinned region in a single-crystal silicon wafer. An etching technique is used to produce a square uniform thinned layer, 87.5 μm on a side and ≃400 Å thick. After removal of the oxide layer, superconducting metals are deposited on both sides. Temperature and magnetic field dependences of the critical current, as well as the magnitude of the current, conform very closely to the theory for a Josephson tunnel junction. This is the first type of Josephson junction employing a barrier which is accessible for modification prior to deposition of the superconducting electrodes. (auth)

8570 1000-A CRYOTRONS FOR SUPERCONDUCTING-MAGNET FLUX PUMPS. Atherton, D.L.; Vilbikaitis, R.J. (Department of Physics, Queen's University, Kingston, Canada). Rev. Sci. Instrum. 45: No. 12, 1520-1522 (Dec 1974).

Cryotrons are being developed for a low temperature flux pump power supply to energize superconducting coils without the excessive helium boiloff characteristic of high current input leads. The cryotrons have been tested to 1200 A at frequencies up to 40 Hz. For 1000 A, the optimum operating frequency is presently 5 Hz (determined by the current transfer rate and the normal cryotron gate resistance). The cryotron gates are Pb-4% Sb and have a normal state resistance of 6 μΩ (resistivity 3.8×10^{-7} Ω-cm). (auth)

8571 REFRIGERATING CYCLES AND LIQUEFIERS. Takada, J. (Japan Oxygen Co. Ltd., Tokyo). Reito; 49: No. 557, 194-201(Mar 1974).

The cooling of superconducting magnets in liquid helium baths is a typical cooling example at the temperature of 4.2°K. The reduction of the cooling cost of superconducting magnets is the most difficult point for the utilization of these magnets. At this temperature, in principle, cooling efficiency is not too bad from the point of thermodynamics. For example, the power consumption for cooling at 4.2°K is 25 times as large as that for cooling at 80°K which is the evaporation point of nitrogen. The thermal efficiency of helium liquefiers was estimated. The power loss in a compressor reaches 40.8% and only 10.2% of the input cooling energy contributes to the liquefaction of helium. Large-size helium refrigerating liquefiers usually operate according to a closed cycle, and are composed of an expansion turbine and an aluminium plate fin-type heat exchanger. The maximum liquefying capacity reaches about 800 l/h at present. As to the application of liquid helium temperature to the electric power industry, the problem of the reduction of refrigerating cost is important. (JA)

8572 HYSTERESIS IN NARROW SUPERCONDUCTING BRIDGES. Nad, F. Ya.; Polyanskii, O. Yu. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 18: No. 11, 1784(Nov 1973).

Translated from Radiotekh. Elektron.; 18: No. 11, 2445-2448 (Nov 1973).

Narrow and short, thin-film superconducting bridges represent one way of achieving a weak coupling between superconductors. Effects, similar to the Josephson effect, are observed in such bridges under certain conditions. A number of the special features of the I-V characteristics of superconducting bridges, including the hysteresis effect, were studied experimentally and the results are interpreted. The bridges were made by the evaporation of Sn and InSn through a specially designed mask onto a glass, quartz or sapphire substrate. The width of the bridges varied within the range from 2 to 8 μm, the thickness, from 500 to 3000 Å. The I-V characteristics and their variation with temperature in the case of bridges of Sn and InSn, from 2 to 6 μm in width, were qualitatively similar. (WHK)

8573 CHARACTERISTICS OF A SUPERCONDUCTING POINT CONTACT JOSEPHSON DETECTOR. Wide-Band Mode of Operation. Likharevm, K. K.; Semenov, V. K. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 18: No. 11, 1734-1741(Nov 1973).

Translated from Radiotekh. Elektron.; 18: No. 11, 2390-2397 (Nov 1973).

Characteristics, such as sensitivity, minimum detectable power and dynamic range-of a superconducting point contact Josephson detector, operating in the wide-band regime, are found within the framework of the conventional model of such a contact. It is shown that the optimum detector parameter values are achieved for relatively high contact resistances where the effect of fluctuations on the I-V characteristic of the contact is large. (auth)

8574 IMPROVEMENTS IN AND RELATING TO SUPERCONDUCTING ELECTRICAL MACHINES. Mulhall, B. E.; Seaman, D. H. (to International Research and Development Co. Ltd.). British Patent 1,360,792. 24 Jul 1974. 5p.

Reference is made to BP 1133720 in which is described a homopolar dynamo-electric machine comprising a stationary superconducting field coil located in a cryostat surrounding but not enclosing a rotor having electrically conducting disks of nonsuperconducting material. In one embodiment, a superconducting screening coil was used to reduce the magnetic field strength in regions where the magnetic field is not usefully employed. The main field coil and the screening coil must be supported so as to maintain fixed positions relative to each other, and the supporting structure can lead to problems due to eddy current heating in circumstances where the intensity of the high magnetic fields in the cryostat changes. This heat must be renewed, with consequent increase in the refrigeration power required. Similar problems can also arise in superconducting machines where the main field coil is split into separate parts. In the arrangement described the machine comprises a rotor and at least two stationary superconducting coils coaxial with the rotor. These coils carry currents in opposite senses in order to generate opposed magnetic fields outside the machine. A cryostat encloses the coils, within which is a supporting structure holding the coils in spaced relationship. This supporting structure comprises a continuous ring coaxial with the coils and located in the region of a surface of zero net flux linkage to minimize eddy current heating. The coils are supported by ribs disposed in planes containing the rotor axis and extending from the ring. (UK)

Heat Transfer and Fluid Flow

Refer also to abstracts 10312, 10318, 10353, 10358, and 10389.

8575 HEAT TRANSFER AND PRESSURE DROP BY FRICTION IN 2-PHASE GAS-LIQUID FLOWS WITH HIGH PORTIONS OF GAS IN HORIZONTAL PIPES. Siegmund, H. W. (Bereich Industrieanlagen, Magdeburg, Ger.). Chem. Tech. (Leipzig); 26: No. 5, 273-277(May 1974). (In German).

For the calculation of the pressure drop for parallel and ring flow there are mathematical-physical relations which give a high accuracy. For the calculation of the heat transmission of a two-phase ring flow two methods were developed. One is the application of similarity relations and the other is the analog analysis of pressure drop-heat transfer. The development of each of these methods is described. (JSR)

8576 INTENSIFICATION OF THE HEAT EXCHANGE DURING CORE FLOW OF FILM BOILING IN TUBES. Kalinin, E. K.; Berlin, I. I.; Kostyuk, V. V.; Kochelaev, Yu. S.; Yarkho, S. A. (Moscow Aviation Inst.). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 2, 67-71(1973). (In Russian).

The experimental results on heat transfer intensification with the help of artificial vortex generators in a two-phase liquid subcooled flow are presented. The high efficiency of heat transfer intensification with film boiling is shown. The design recommendations on heat transfer and hydraulic resistance are given in the form of the relations depending upon regime parameters and sizes of vortex generators. A brief analysis of a process mechanism is given. (auth)

8577 EXPERIMENTAL INVESTIGATION OF NATURAL CONVECTION WITH VERTICAL CYLINDERS IN MERCURY. Wiles, L. E.; Welty, J. R. (Oregon State Univ., Corvallis). Contract AT(45-1)-2227. J. Heat Transfer; 96: No. 4, 455-458(Nov 1974).

An experimental investigation of laminar natural convection heat transfer from a uniformly heated vertical cylinder immersed in an effectively infinite pool of mercury is described. A correlation was developed for the local Nusselt number as a function of local modified Grashof number for each cylinder. A single equation incorporating the diameter-to-length ratio was formulated that satisfied the data for all three cylinders. An expression derived by extrapolation of the results to zero curvature (the flat plate condition) was found to agree favorably with others' work, both analytical and experimental. The influence of curvature upon the heat transfer was found to be small but significant. It was established that the effective thermal resistance through the boundary layer is less for a cylinder of finite curvature than for a flat plate. Consequently, local heat transfer coefficients for cylinders are larger than those for flat plates operating under identical conditions. (auth)

8578 TWO-PHASE HIGHLY DISPERSED FLOWS. Cumo, M.; Farello, G. E.; Ferrari, G.; Palazzi, G. (CNEN, Rome). J. Heat Transfer; 96: No. 4, 496-503(Nov 1974).

Experimental research on highly dispersed, two-phase, turbulent flows was performed employing Freon 12 at different pressures up to the critical value. By means of visualization techniques it was possible to study the droplet size distribution, their spatial concentration, and the relationships among the deduced law of distribution and the main thermo-hydraulic parameters for different thermo-hydraulic conditions (pressure, mass velocity, and quality). Simple relations were developed which make it possible to determine, at least for some reference thermo-hydraulic situations, all of the characteristics of the liquid dispersed phase. (auth)

8579 EXPERIMENTAL FREQUENCY RESPONSE CHARACTERISTICS FOR DIABATIC TWO-PHASE FLOW IN A VERTICAL MONOTUBE VAPOR GENERATOR. Paul, F. W. (Carnegie-Mellon Univ., Pittsburgh); Riedle, K. J. J. Heat Transfer; 96: No. 4, 504-510(Nov 1974).

Experimental data are presented on the dynamic behavior of diabatic two-phase flow in a vertical tube with Refrigerant-11 as the working fluid. A detailed description is included of the experimental test facility as well as the instrumentation used for monitoring the variables of pressure, flow, heat flux, and void fraction. Experimental data are presented in frequency response form for inlet impedance ($\Delta P_1/\Delta W_1$) and exit void fraction ($\Delta\alpha_3/\Delta W_1$) at constant heat flux over a frequency range of 0.01 to 10.0 Hz. The data cover inlet subcooling conditions of 14°F and 79°F and two heat flux levels. The experimental results show that the inlet impedance characteristics have fluctuations in amplitude and phase lag with frequency which lead to resonant peaks in the overall frequency response behavior. Exit void fraction characteristics show similar resonant behavior with large phase lag at frequencies above 1 Hz. (auth)

8580 MATHEMATICAL MODEL FOR TRANSIENT SUBCHANNEL ANALYSIS OF ROD-BUNDLE NUCLEAR FUEL ELEMENTS. Buettiker, P. (Swiss Federal Inst. for Reactor Research, Wuerenlingen, Switzerland). J. Heat Transfer; 96: No. 4, 565-566(Nov 1974).

Contradictions in assumptions used in developing a mathematical model of two-phase flow through a reactor fuel rod bundle are discussed, and are rebutted by the developer of the model. (LCL)

8581 FINITE ELEMENT ANALYSIS OF STEADY-STATE NONLINEAR HEAT TRANSFER PROBLEMS. Donea, J.; Giuliani, S. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Nucl. Eng. Des.; 30: No. 2, 205-213(1974).

A method of analysis and the associated computer program are presented for the purpose of solving steady-state nonlinear heat transfer problems in two-dimensional structures. The nonlinearity arises from the dependence of the thermal conductivities on temperature as well as from the presence of radiative heat transfer between parts of the structure. The problem is formulated in terms of an integral of conductivity and solved in an iterative way via the finite element concept. Several examples are given to illustrate the validity and practicality of the suggested solution technique. (auth)

8582 TYPE OF FLOW, PRESSURE DROP, AND CRITICAL HEAT FLUX OF A TWO-PHASE SODIUM FLOW. Kaiser, A.; Peppler, W.; Voeroess, L. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Nucl. Eng. Des.; 30: No. 3, 305-315(1974).

Little is known about the two-phase pressure loss, the flow pattern, and the critical heat flux conditions for boiling sodium under forced convection. The specific thermohydraulic properties of sodium prohibit extrapolation to sodium of experimental data obtained for other liquids. Therefore, some new test series were carried out in a sodium loop with an induction heated test section of 9 mm inner diameter and 200 mm heated length. The two-phase pressure loss and the film thickness were measured up to the critical cooling conditions. The experimental results are compared with values predicted by known models on annular flow and annular mist flow, respectively. Satisfactory predictions of the flow pattern and the critical heat flux conditions could only be obtained using the measured two-phase pressure losses. (auth)

8583 EFFECT OF THE THERMAL CONDUCTIVITY OF A SURFACE LAYER ON CONTACT THERMAL RESISTANCE. Kharitonov, V. V.; Kokorev, L. S.; Tyurin, Yu. A. Sov. At. Energy (Engl. Transl.); 36: No. 4, 385-387(Apr 1974).

Translated from At. Energ. (USSR); 36: No. 4, 308-310(Apr 1974).

The contact thermal conductivity α_c W/m^2.deg is one of the important characteristics of heat exchange in fuel elements and anode packets of thermionic converters. The quantity α_c may decrease appreciably during the formation of oxide films on adjacent metal surfaces and may increase considerably if layers of metals with high thermal conductivity are deposited on the surfaces in contact. That part of α_c which depends on the surface properties of the materials is determined by the density of the contact spots n(m^{-2}) and the resistances R_1 and R_2 (deg/W) of constriction of the lines of heat flux to these spots in both bodies, i.e., $\alpha_c = n/(R_1 + R_2)$. A complete calculation of R is presented with the purpose of obtaining valid recommendations for the choice of the optimum thickness of the coatings and for estimates of α_c in the presence of oxides and other surface layers. (RCK)

Materials Testing

8584 (SAND-74-8246) NONDESTRUCTIVE IDENTIFICATION OF CUSIL BRAZE MATERIAL BY NEUTRON ACTIVATION ANALYSIS. Dolan, K. W.; Dahlke, L. W. (Sandia Labs., Livermore, Calif. (USA)). Dec. 1974. Contract AT(29-1)-789. 15p. Dep. NTIS $4.00.

Neutron activation analysis was used as a nondestructive technique to positively distinguish between cusil (28% Cu, 72% Ag) and silver braze material bonding electrical leads to the substrate of a large scale integration circuit (LSI). The SLL californium-252 source was used to activate LSI samples and a small volume Ge(Li) spectrometer was used to observe the characteristic radiations. Based on these results, it is concluded that an exposure of the braze material for twenty-four hours to a thermal neutron flux of 10^7 neutrons/cm^2/sec will produce sufficient activation to positively identify the cusil braze parts. Thermal neutron fluxes of this order, and large exposure areas, are available at nuclear reactor facilities. Using a large volume Ge(Li) gamma-ray spectrometer to observe the characteristic radiations from copper-64, the counting interval per part would be approximately 100 sec. The neutron sensitive LSI chips can be shielded with cadmium foil to reduce the thermal neutron fluence to an insignificant level. (auth)

8585 EDDY CURRENT TESTING OF STAINLESS STEEL NUCLEAR FUEL CLADDING TUBES. Ito, H.; Uetake, I. (National Research Inst. for Metals, Tokyo). Trans. Nat. Res. Inst. Metals (Tokyo); 15: No. 5, 224-233(Sep 1973).

An eddy current testing method for fast breeder reactor nuclear fuel cladding tubes was studied. The instrument with a single coil and a precise impedance bridge was used for the testing and coil impedance measurement of defects in the frequency range of 300 kHz ~ 1.2 MHz. Methods of optimizing the testing parameters for detection of defects, test frequency, bridge balance setting, filtering frequency, and test speed were investigated. By micrographic examination of the parts where defect indications appeared, it was found that the tester can successfully detect small defects as required in the specifications for fuel cladding tubes (slit 25 μ in depth on the outer and inner surface). The accumulative effect of the distributed defects on the test indication, and noise due to the magnetic precipitate after heat treatment are discussed. (auth)

8586 TECHNICAL AND ECONOMIC INVESTIGATION OF THE RADIATION INSPECTION OF WELD JOINTS. Berdonosov, V. A.; Gorbunov, V. I.; Prokof'ev, Yu. S.; Shkarina, G. T. (Tomsk Polytechnic Inst., USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 1, 86-88(1974).

Translated from Defektoskopiya; 10: No. 1, 108-111(1974).

The results of technical and economic investigations of radiation methods for inspecting the quality of weld joints up to 50 mm are given. The relationships of the primary economic parameters, inspection productivity and adjusted costs, to the thickness of the joints inspected, the scale of production, and the inspection method are given. (auth)

8587 SOME NEW DEVELOPMENTS IN NONDESTRUCTIVE TESTING. Reynolds, W. N. J. Phys., E (London); 6: 8-13(Jan 1973).

Some recent (1969 to 1972) developments in nondestructive testing are reviewed. Subjects discussed include ultrasonic holography, ultrasonic goniometry, acoustic emission, internal damping, eddy current testing, microwave testing, and advances in radiography. The article is brief yet informative. (Appl. Mech. Rev.)

8588 NEUTRON RADIOGRAPHY WITH VERY COLD NEUTRONS. Bates, J. C.; Roy, S. (Universities Research Reactor, Risley (UK)). Nucl. Instrum. Methods; 120: No. 2, 369-370 (1 Sep 1974).

An attempt has been made to extend the application of neutron radiography by using neutrons for which absorption cross sections are of the order of 100 times greater than the values at 2200 m/s. (auth)

Nuclear Explosions

8589 (AD-780088) ANALYSIS OF CODA AND MULTIPATH PROPAGATION OF RAYLEIGH WAVES AT NORSAR. Bungum, H.; Capon, J. (Norges Teknish Naturvitenskapelige Forskningsraad, Kjeller, NORSAR). 3 Jan 1974. Contract F44620-74-C-0001. 62p. NTIS $6.25.

Frequency-wave number analysis of coda of 40 and 20 sec Rayleigh waves recorded at NORSAR shows that 40 sec period coda drops off faster vs. time while the resolving power of the array is better at 20 sec. Multipath arrivals with as much as 40 to 60 degrees are frequently identified, and travel path solutions for some events are proposed. As an example, 20 sec Rayleigh waves from a nuclear explosion are identified in the presence of an interfering event. (GRA)

8590 (AD-783239) CHEMP: A CODE FOR CALCULATION OF HIGH-ALTITUDE EMP. Final Report, March–December 1973. Wittwer, L. A.; Canavan, G. H.; Brau, J. E. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jul 1974. 24p. (AFWL-TR-74-49). NTIS $3.00.

CHEMP is a code originally designed to examine the effects of self-consistency on high-altitude fields by using a particle pushing model for the current calculation and the high-frequency approximation for calculating the fields. CHEMP has been extended to study the effects of nonforward Compton scattering, varying gamma energies, and elastic nuclear scattering. (auth)

8591 (PNE-RB-64) SEISMIC EFFECTS PROGRAMS. Project Rio Blanco. (CER Geonuclear Corp., Las Vegas, Nev. (USA)). 21 Oct 1974. 52p. Dep. NTIS $5.75.

Results of several seismic effects programs carried out in connection with Project Rio Blanco are summarized. These programs include: a seismic array to monitor the ground motion resulting from the detonation at distances varying from 3.7 miles to 93 miles from the emplacement well (EW); two seismic arrays to detect the aftershocks of the detonation and to locate the hypocenters of these aftershocks; a seismic array to study the correlation of structural damage to low-level ground motion; a seismic array to study structural response to the ground motion; a seismic array to monitor the ground spall caused by the detonation; an instrumental array to monitor changes in pore pressure resulting from the seismic wave; a structural bracing program to minimize the damage caused by the ground motion; a pre- and postdetonation inspection of selected bridges in the area to detect any change due to ground motion; a pre- and postdetonation inspection of the oil and gas wells within 7 miles of the EW; a postdetonation inspection to locate and document the reported rock falls due to the ground motion; a pre- and postdetonation inspection of springs and wells out to a distance of 10 miles from the EW; predetonation microtremor surveys in Rifle, Meeker, Rangely, De Beque, and Grand Valley with postdetonation correlation to damage claims; El Paso Natural Gas Program; a pre- and postdetonation inspection of all the mines and quarries within 53 miles of the EW; damage claims and adjustments; and structural inventory and damage assessment. (TFD)

8592 EXTENT OF PERVASIVE FRACTURING AROUND UNDERGROUND NUCLEAR EXPLOSIONS. Borg, I. Y. Int. J. Rock Mech. Mining Sci.; 10: No. 1, 11-18(Jan 1973).

A compilation of fracture data around underground nuclear explosions is presented. Horizontal fracture radii, as judged by in situ permeability measurements, observed microfracturing in postshot cores, chimney pressurization tests, and macrofracturing in cores and tunnels, tend to be 2.7 to 3.5 r_c (cavity radius) in competent rocks. Pervasive fracturing below the shot point is on the order of 2.0 r_c. Brittle rock whose Hugoniot elastic limit has been exceeded are intensely fractured (crushed). The degree of fracturing falls off sharply at peak radial pressures less than this amount. A least-squares fit of measured chimney height for rock other than alluvium gives the relation $h_c = 0.88\ r_c^{1.5}$. As predicted by Butkovich and Cherry, h_c corresponds to the limit of shear failure, which is sensitive to the strength properties of the media, overburden pressure, and yield of the explosion. (Appl. Mech. Rev.)

8593 INTERPRETATION OF BODY AND RAYLEIGH WAVES FROM NTS TO TUCSON. Langston, C. A.; Helmberger, D. V. (California Inst. of Tech., Pasadena). Bull. Seismol. Soc. Amer.; 64: No. 6, 1919-1929(Dec 1974).

A linear array of eight Caltech portable broad-band seismograph trailers was set out from NTS to near Phoenix, Arizona, for the pre-announced underground nuclear test, OSCURO, on September 21, 1972. Travel-time and amplitude information were used to find an average crustal model by calculating synthetic seismograms using the Cagniard-de Hoop method. Rayleigh waves from other nuclear events at NTS, as recorded at the Tucson WWSSN station, were examined as a control for determining the structure of the top half of the crust. Group-velocity curves were found and synthetic Rayleigh waves calculated for Tucson and Kingman (LRSM). The formations and characteristics of P_n, a reflected P_n, and the P_g phases are examined. P_g is demonstrated to be composed of the primary P reflection from the mantle and contains multiple arrivals of P–SV conversions. Comparisons of synthetic and observed seismograms indicate a crustal thickness of 30 km with a Poisson's ratio of 0.23. The crust-mantle transition appears to be sharp, jumping from 6.1 to 7.9 km/sec. The amplitude behavior of P_n shows little evidence of any lid structure (auth)

8594 LOW-RISE BUILDING DAMAGE FROM LOW-AMPLITUDE GROUND MOTIONS. Scholl, R. E. (John A. Blume and Associates, Las Vegas, NV). Bull. Seismol. Soc. Amer.; 64: No. 6, 1743-1755(Dec 1974).

Data on offsite low-rise building damage from underground nuclear testing at the U. S. Atomic Energy Commission's Nevada Test Site are available for seven large tests in the period from 1966 to 1970. The data, while sparse, provide an adequate sample for the investigation of motion-damage relationships. Damage in the study is statistically described in terms of the incidence of damage complaints, the incidence of buildings damaged, and damage cost. Using 5% damped response-spectrum acceleration amplitude to characterize ground motion, the plotted data fit reasonably well with previous motion-damage relationships established from extensive data available from the 1969 RULISON underground nuclear explosion experiment conducted in western Colorado. (auth)

8595 SEISMIC EVENT IDENTIFICATION BY NEGATIVE EVIDENCE. Elvers, E. (Research Inst. of National Defense, Stockholm). Bull. Seismol. Soc. Amer.; 64: No. 6, 1671-1683 (Dec 1974).

A decision-theoretical model for seismic discrimination between earthquakes and underground nuclear explosions is developed. The influence of long- and short-period detection thresholds on the probabilities to identify explosions and to make false alarms is discussed. The model includes identification by negative evidence. This kind of identification is considered in the case when only short-period data are available and when the long-period signal amplitude is supposed to be less than or equal to the seismic noise amplitude. For one set of data—obtained from North American events at the Hagfors Observatory in Sweden—the applicability of the m(M)-method is increased about half a magnitude by including identification by negative evidence. (auth)

8596 TRAVEL-TIME RELATIONS FOR THE UPPER MANTLE P-WAVE PHASES FROM CENTRAL ALASKAN DATA. Biswas, N. N.; Bhattacharya, B. (Univ. of Alaska, Fairbanks). Bull. Seismol. Soc. Amer.; 64: No. 6, 1953-1965(Dec 1974).

The travel-time relations for the upper mantle P-wave phases in the epicentral distance range of 700 to 4500 km are described. The short-period data analyzed were from underground nuclear explosions in central Aleutian and Nevada regions and from earthquakes located along the north Pacific seismic belts; the data were recorded by the central Alaskan seismic network. The observations could be explained by three linear relations: the first extends from 700 to 1900 km with apparent velocity of 8.29 km/sec, the second is between 1900 and 2850 km with apparent velocity of 10.39 km/sec and the third extends from 2850 to 4500 km with apparent velocity 12.58 km/sec. In the epicentral distance range of 1900 to 2600 km, the first P-wave arrivals from earthquakes in the Aleutian area were found systematically late by 3 to 4 sec compared with those from central Aleutian underground nuclear explosions. This discrepancy in travel times has been interpreted as due to mislocations and errors in origin time for earthquakes in the above area. Also, the well-known 400- and 600-km discontinuities in the upper mantle have been correlated with the sharp changes in travel-time gradients at 1900 and 2850 km, respectively. (auth)

Protective Structures and Equipment

Refer also to abstract 9304.

8597 (CEA-CONF-2690) DEFINITION OF THE MINIMUM COST OF AN AIR FILTRATION SYSTEM WITH VERY HIGH

EFFICIENCY. Billard, F.; Seau, C. (CEA Centre de Production de Plutonium de Marcoule, 30—Bagnols-sur-Ceze (France)). 1974. 12p. (In French). (CONF-740568-1). Dep. NTIS (US Sales Only) $4.00.

From 1st world congress on filtration; Paris, France (14 May 1974).

Studies were made to determine the minimum cost of a highly efficient air filtration system for nuclear installations. The factors leading to the optimization of a filtration installation are defined and evaluated. The evaluation is applied to the optimization of the existing installations of the Marcoule center. The optimization of the use of a filtration system is considered from the viewpoint of the monitoring of the filters during use, use of build-up curves, and build-up reserve and capacity of the ventilators. The length of use of the filter and the optimum capacity of the ventilators are calculated. (JSR)

8598 METHOD OF AND FILTER FOR REMOVING TRITIUM FROM INERT GASES. Cooper, M. H. (to United States Atomic Energy Commission). US Patent 3,848,067. 12 Nov 1974. Filed Date 12 July 1972. 4p.

A trap for removing tritium from an inert gas and method of doing the same comprising divided yttrium coated by nickel contacted by said gas are described. (Official Gazette)

Safety Engineering

8599 (SC-M-72-0777B) TA-V EMERGENCY PLAN: REVISION 2. Estes, B. F.; Thome, F. V. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1974. Contract AT(29-1)-789. 73p. Dep. NTIS $6.75.

The TA-V Emergency Plan establishes (1) an emergency philosophy for the guidance of TA-V personnel and (2) an organization for dealing effectively with major and minor emergencies as they arise. (auth)

8600 (UCRL-50007-74-1) HAZARDS CONTROL PROGRESS REPORT NO. 48, JANUARY—JUNE 1974. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jul 1974. Contract W-7405-eng-48. 41p. Dep. NTIS $4.00.

Progress and technical notes on the following topics are given: comparison of Si(Li) and twixtel detectors for measuring Pu lung burdens; separation of HT, noble gases, and HTO vapor with semi-permeable membranes; progress in determining neutron dose equivalent at the Hazards Control Calibration Facility; effect of concentration on respirator cartridge efficiency; use of ultraviolet light transmission for determining track densities in dielectric materials; beta spectrometer; a system to produce low concentrations of gas in air; cartridge and canister test system for the Testing and Certification Laboratory; tritium surface contamination monitor; neutron spectrometer development; a method for safe handling of $^{238}UH_3$ waste; plant test of liquid decontamination process; a weighted linear least-squares program with error estimates; tritium analysis of alpha-contaminated oil; a computer program to calculate ear protector noise attenuation; a low-level fluorine detector; a computer program to size and balance exhaust ventilation systems: contribution of alpha particle tracks to fission fragment spark counting backgrounds; and DOSIIDT, a program to decode PDP-11 disk operating system (DOS) dectapes. (TFD)

Vacuum Engineering

8601 ULTRAHIGH VACUUM SYSTEM FOR THE STUDY OF THE MECHANICAL AND ELECTRICAL PROPERTIES OF METALLIC SURFACES. Cuthrell, R.E. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Vac. Sci. Technol. 11: No. 6, 1166-1169 (Nov 1974).

A bakeable ultrahigh vacuum system was constructed for the study of the mechanics of deformation, contact resistance, bonding, friction, and high—resolution topography of metallic surfaces in contact. The instrument consists of a work chamber which is isolated from building vibrations and in which metallic samples may be cleaned by sputtering, annealed by electron bombardment, and brought together with precise control of mechanical and environmental variables. Facilities are provided for load and contact resistance measurements. A laser interference fringe microscope, which is mounted in the work chamber, is used for quantitative surface topography determinations and the measurement of load—bearing areas. This system has been used for electrical contact and solid—phase bonding studies. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 8773 and 8961.

8602 (CEA-1173) CONTRIBUTION TO URANIUM GEOCHEMISTRY IN INTRUSIVE GRANITES. Coulomb, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1959. 83p. (In French). Dep. NTIS (US Sales Only) $7.25.

Thesis. Submitted to Paris Univ. (France).

This work aims to define the position of a certain number of French granitic deposits within the field of the geochemistry of granites in general, and at the geochemistry of uranium in particular. The regions concerned are: 3 French hercynian ranges, in the Vendée, in Brittany and in the Morvan, and 1 African range, probably precambrian, of the Hoggar. For each range the petrochemical framework is first of all determined and then the degree of chemical homogeneity of the rocks is evaluated. In the petrochemical groups thus obtained the geochemical behaviour of the uranium is studied. From the viewpoint of the geochemistry of the granites under investigation, a comparison of the laws of distribution of the major elements in the 4 ranges shows up a convergence of average composition which was not anticipated by geological and petrographic considerations alone. The statistical and geochemical distribution laws of the total uranium as a function of the petrochemical variations are established. A study of the chemical forms of uranium in the rocks has drawn an attention to the qualitative and quantitative importance of the fraction of this uranium soluble in dilute acids. Therefore, on the one hand, the laws of distribution of the insoluble uranium, which represents essentially the uranium fixed in crystalline structures (zircon, allanite ...) are reconsidered and, on the other hand, the interest presented by the soluble uranium is justified; this, although more complex in character, presents a geochemical unity in postmagmatic phenomena which makes possible to find a genetic connection between the uraniferous deposits and the intrusive massifs. Finally a plan of the geochemical cycle of uranium is given which may provide some more accurate data on the igneous phase. (auth)

8603 (NP-20232) DISTRIBUTION OF URANIUM IN UPPER CAMBRIAN ALUM SHALE FROM RANSTAD, BILLINGEN, VAESTERGOETLAND. Edling, E. (Uppsala Univ. (Sweden)). Apr 1974. 119p. (In Swedish). Dep. NTIS (US Sales Only) $9.00.

Thesis.

Uranium is very uniformly distributed in the Billingen area of Sweden. The distribution in general is dependent on the lithology of the area, which is of broadly similar character. It is also related to the paleogeography of the area and to the character of the sedimentation environment. The present uranium distribution is also a result of radical diagenetic changes in the Billingen shale, which to a large extent are altogether unknown. A large number of factors have accordingly contributed to the present distribution, and a large number of unknown factors may have had a great significance. One such uncertain factor is the subsoil water, a knowledge of the significance of which is lacking. Another is the significance of the later intruding diabase. (auth)

8604 DISTRIBUTION AND OCCURRENCE OF RARE EARTHS IN THE THORIUM VEINS ON HALL MOUNTAIN, IDAHO. Staatz, M. H.; Shaw, V. E.; Wahlberg, J. S. J. Res. U. S. Geol. Surv.; 2: No. 6, 677-683(1974).

Rare earths, although equal to or more abundant than thorium in many thorium veins, are much less abundant than thorium in the veins on Hall Mountain, Idaho. Total rare-earth content of these veins ranges from 0.00111 to 0.197% in 12 samples from 10 veins; the thoria (ThO_2) content, from 0.011 to 5.84%. The rare-earth oxide to thoria ratios range from 0.0019 to 3.22. Only two samples contained more rare earths than thorium, and these two samples came from veins related to a fault near the base of a thick sill; the others came from veins near the top of the same sill. The relative amounts of the individual lanthanides are remarkably similar in the Hall Mountain veins, although cerium, gadolinium, or dysprosium are the most abundant in different samples. These veins differ in lanthanide distribution both from the Earth's crust and from the thorium veins of the Lemhi Pass district, Idaho and Montana, in that they contain chiefly yttrium-group rare earths. Most of the rare earths occur in thorite, whose atomic structure will accommodate wide-ranging proportions of the rare earths. Cenosite, one of the few minerals with a high content of the yttrium group of rare earths, was found in one vein. (auth)

8605 ANALYSES AND ECONOMIC POTENTIAL OF MONAZITE IN LIBERIA. Rosenblum, S. J. Res. U. S. Geol. Surv.; 2: No. 6, 689-692(1974).

Eleven monazite samples from Liberia, including seven from beach sands, were analyzed by the x-ray fluorescence method. The monazite samples, containing only one-half percent impurities, were obtained by use of a hot Clerici-solution procedure for purification which was devised by the author. The percentage of the rare-earth elements in Liberian monazite concentrates does not differ greatly from that of monazite sands elsewhere in the world. The average of the 11 samples shows less praseodymium and neodymium than Russian and American monazites, but more cerium. Liberian coastal sands apparently contain sufficient reserves of monazite (and other heavy minerals of commerce) to encourage mining. A feasibility study of production and marketing of monazite from Liberian beach sands is recommended. (auth)

8606 ^{210}Pb AND STABLE LEAD ISOTOPES IN LAKE SEDIMENTS. Petit, D. (Brussels Univ. (Belgium)). Earth Planet. Sci. Lett.; 23: No. 2, 199-205(Sep 1974). (In French).

^{210}Pb measurements were carried out on the sediments cores from a small south Belgian pond. In two cores, the ^{210}Pb activity decreases exponentially with depth. Under various assumptions described in the article, the corresponding accumulation rates would be of the order of 60-100 mg/cm^2 of dried sediment per year. The stable lead content greatly increases from the older to the more recent sediment. This increase is accompanied by a change in isotopic composition: from the bottom to the top of the cores, the lead isotopic composition becomes progressively less radiogenic, reaching at the surface values identical to that for present atmospheric lead. (auth)

8607 ISOTOPIC MEASUREMENTS OF RUBIDIUM AND STRONTIUM AND ATTEMPTS TO MEASURE THE MINERALISATION AGE OF URANIUM FROM THE OKLO NATURAL FOSSIL REACTOR. Hagemann, R.; Lucas, M.; Nief, G.; Roth, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91— Gif-sur-Yvette (France). Dept. de Recherche et Analyse). Earth Planet. Sci. Lett.; 23: No. 2, 170-176(Sep 1974). (In French).

Isotopic anomalies in uranium and characteristic isotopic composition of rare earths initiated the discovery of the fossil chain reaction in Oklo. In view of their significance in interpreting the phenomena observed, a more exact method of dating the mineralization and chain reaction was attempted. One might first consider the use of isotopic analysis of rubidium and strontium extracted from mineral samples from the Oklo fossil reactor; however, the results show that isotopes of these elements produced during uranium fission have migrated with respect to uranium. Therefore, it is not possible to determine the age of the nuclear reaction from the radioactive decay of ^{87}Rb produced in fission. These migrations can be compared to those reported at the microscopic scale by other authors. The U- Pb method applied to determine the age of the uranium ore shows large variations in the Pb/U ratio which appear to have been produced very recently. Thus, the apparent age of 1800 m.y. found for the uranium deposition needs the support of further experiments. New methods to infer this age are proposed. (auth)

8608 GEOLOGICAL CONDITIONS IN THE AREA OF THE URANIUM ORE DEPOSIT AT OKROUHLA RADOUN NEAR JINDRICHUV HRADEC. Mrazek, P. Sb. Geol. Ved, Loziskova Geol.; 15: 83-97(1972). (In Czech).

New findings are outlined such as were gained in a geological survey made in the area of catazonal metamorphic rocks of the Moldanubian type with numerous apophyses of granitoid intrusions of the Variscian age Klenov massif. The late Variscian radial tectonics has created several fractures running from north to south, in some places with mineral deposits. The most significant of these locations is the hydrothermal vein mineralization with uraninite, galenite, chalcopyrite, sphalerite. The main suture of the fracture was reactivated by neotectonics, thus dispersing the uranium mineralization tectonically and hydrogeologically in the form of uranium blocks. (INIS)

8609 URANIUM DEPOSIT AT DAMETICE, SOUTH OF HORAZDOVICE. Janout, T. Sb. Geol. Ved, Loziskova Geol.; 15: 67-81(1972). (In Czech).

A uranium deposit located in the Moldanubian mineral layers is discussed. The deposit is tectonically linked with the quartz lode in the north-east direction. By its mineral content, the deposit is of a sulphide-uraninite type with a powerful zone of oxidation. The history of the discovery of the deposit, the geological conditions thereof and a brief survey of work in the area are presented. (INIS)

Radioactivity Monitoring and Transport

Refer also to abstracts 8296, 8761, 8868, 8873, 8874, 8876, 8952, and 8966.

8610 (RISO-305) ENVIRONMENTAL RADIOACTIVITY IN DENMARK IN 1973. Aarkrog, A.; Lippert, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jun 1974. 99p. Dep. NTIS (US Sales Only) $8.00.

Results are reported from measurements of fall-out radioactivity in Denmark in 1973. Strontium-90 was determined in samples from all over the country of precipitation, soil, ground water, stream and lake water, seawater, grass, dried milk, fresh milk, grain, bread, potatoes, vegetables, fruit, total diet, drinking water, and human bone. Furthermore ^{90}Sr was determined in local samples of air, rain water, grass, sea plants, fish, and meat. Cesium-137 was determined in soil, seawater, milk, grain products, potatoes, vegetables, fruit, total diet, and meat, and ^{137}Cs was measured by wholebody counting in persons from a control group at Risø. Estimates of the mean contents of radiostrontium and radiocesium in the human diet in Denmark in 1973 are given. The γ-background was measured regularly at locations around Risø, at ten of the State experimental farms and in an area in Zealand, one in Jutland where future nuclear power plants might be located, and along the shores of the Great Belt. The report includes results of regular surveys of environmental samples from the Risø area. (DE)

8611 (RISO-306) ENVIRONMENTAL RADIOACTIVITY IN THE FAROES IN 1973. Aarkrog, A.; Lippert, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jul 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

Measurements of fallout radioactivity in the Faroes in 1973 are presented. The content of ^{90}Sr (and ^{137}Cs in most instances) was determined in regularly collected samples of precipitation, grass, milk, fish, seawater, bread, and drinking water. In addition, analyses of spot samples of lamb, potatoes, sea plants, vegetables, eggs, and human bone were carried out. Estimates of the mean contents of ^{90}Sr and ^{137}Cs in the human diet in the Faroes in 1973 are given. (DE)

8612 (SZS-157, pp 6-11) RADIATION PROTECTION MONITORING AND NUCLEAR ENVIRONMENTAL PROTECTION IN THE GERMAN PEOPLE'S REPUBLIC. Blume, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The monitoring program established in East Germany for detection of the type and degree of contamination during the era of nuclear warfare research and atmospheric explosions of nuclear weapons is outlined. The minimum program developed after the cessation of most atmospheric testing was given. The necessity for establishing new programs to deal with the problems generated by nuclear power plants and processing plants is discussed, and the steps made in that direction are outlined. (JSR)

8613 (SZS-157, pp 15-21) USE OF MINING REFUSE WITH INCREASED RADIONUCLIDE CONTENT. Roehnsch, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The existence of large masses of mining wastes and the need for additional construction materials has led to the use of these wastes in construction. However the processing of the ores has frequently resulted in increased radionuclide content of the wastes primarily from the U–Ra decay series. Therefore the radionuclide content of the wastes must be determined, the applications planned must be evaluated, and the radiation burden resulting from the use of these wastes must be determined. The maximum permissible values for ^{226}Ra concentration in the wastes being used for road construction and for the construction of closed areas are calculated. The conditions for the use of these waste materials are outlined. (JSR)

8614 (SZS-157, pp 22-27) STUDY AND STANDARDIZATION OF THE RADIOACTIVITY OF STRUCTURAL MATERIALS. Krisyuk, E. M.; Tarasov, S. I.; Shamov, V. P.; Shalak, N. I.; Lisachenko, E. P.; Gomel'skii, L. G. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

Concentrations of Ra, Th, and K were measured by gamma spectrometry in more than 300 samples of construction materials used in various regions of the country. The results obtained and the calculated values of the doses resulting from the use of these materials are tabulated. The effective concentration of Ra and the coefficient of emission of construction materials are also tabulated. Radon diffusion in heavy concrete, light concrete, and bricks was calculated. (JSR)

8615 (SZS-157, pp 28-32) SANITARY STANDARDIZATION OF RADIOACTIVE ISOTOPES IN FRESH WATER RESERVOIRS (PERTINENT PRINCIPLES, CRITERIA, AND CALCULATION METHODS). Marei, A. N.; Zaitseva, A. F.; Barkhudarov, R. M. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

Basic principles used in the establishment of standards for the radioisotopic content of reservoirs are outlined. The difficulties in establishing specific criteria because of the different uses of the water and its natural characteristics are considered. Methods for calculating the accumulation coefficient and the migration of radionuclides from soils into milk and for evaluating the permissible concentrations of specific isotopes on the basis of a series of tests are given. The results obtained in the calculation of these factors are tabulated for some isotopes. (JSR)

8616 (SZS-157, pp 46-49) HEALTH PHYSICS EVALUATION OF THE EXISTING SYSTEMS OF CENTRAL DISPOSAL AND BURIAL OF RADIOACTIVE WASTES OF LOW AND MEDIUM ACTIVITY. Bashmakova, T. A. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The present systems used in the Soviet Union for the central disposal and burial of radioactive wastes of average and low activity were evaluated from the health physics viewpoint. It was concluded that the systems being used ensure complete safety to the population. (JSR)

8617 (SZS-157, pp 116-126) RESULTS AND CONCLUSIONS OF FALLOUT MONITORING. Kunert, J.; Moldenhawer, F. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The atmospheric, soil, plant, water, and food monitoring program carried out in East Germany is briefly described and its most significant results reported. The possibility of predicting the evolution of the environmental contamination and the estimation of transfer functions on the basis of the fallout data accumulated is discussed. (JSR)

8618 (SZS-157, pp 127-135) ARTIFICIAL SOURCES OF NATURAL RADIONUCLIDES IN THE ENVIRONMENT. Jaworowski, Z.; Bilkiewicz, J.; Kownacka, L.; Wlodek, S. (Central Lab. for Radiation Protection, Warsaw). Mar 1974.

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

Volcanic fumes, wind transfer of seawater and soil, forest fires, and meteoritic dust are discussed as natural sources of ^{226}Ra. Artificial sources of ^{226}Ra discussed are coal burning, milling of uranium, cement production, and phosphate fertilizers. Tables are presented to show ^{226}Ra concentrations in dry fallout and in snow around power stations, in glacier ice, and in pine trees. It is pointed out that the dominant natural source of ^{210}Pb in the atmosphere is ^{222}Rn exhaled from the ground. Other sources of ^{210}Pb in the atmosphere are combustion of tetraethyl lead in motor vehicle gasoline, burning of fossil fuel, and nuclear explosions. (HLW)

8619 (SZS-157, pp 136-137) TREND AND METHODS OF FOLLOWING THE ENVIRONMENTAL CONTAMINATION FROM RADIOACTIVE FALLOUT. Kunz, E.; Brezik, Z.; Brezikova, D. (Institut fuer Hygiene und Epidemiologie, Prague). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The discussion of the direction and methods of monitoring the environmental contamination is limited to a consideration of ^{90}Sr. The accumulation of ^{90}Sr in the bones of deceased inhabitants of Prague was systematically followed since 1964. The methods of monitoring the food chain for ^{90}Sr contamination and accumulation are outlined. The problem of radionuclide kinetics is indicated. (JSR)

8620 (SZS-157, pp 152-158) RESULTS AND CONCLUSIONS OF THE ENVIRONMENTAL MONITORING OF NUCLEAR INSTALLATIONS. Ettenhuber, E.; Roehnsch, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The monitoring program initiated in 1962 to monitor the environments of nuclear installations is briefly described and includes monitoring aerosols, fallout, water, mud, water plants, fish, soil, pine needles, and grass and the measurement of the dose rate at various points around an installation. The results show that the γ dose rates are lower after the start-up of a nuclear installation. The concentration of radioactive aerosols in the ground-level atmosphere has fluctuated over the years. The annual sum of the overall β activity in fallout is tabulated for various sites from 1967 to 1970. It was concluded however that the program did not permit the calculation of the radiation burden caused by the operation of a nuclear installation. A stepped program that permits such calculations is briefly described. (JSR)

8621 (SZS-157, pp 169-176) BURDEN MODEL: CONTRIBUTION OF AN INDUSTRIALLY CONNECTED ENVIRONMENTAL MONITORING. Zindler, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The necessity for a reliable and accurate mathematical model of the total system of the environment of a nuclear installation is indicated. The individual terms of such a model are described. The use of the model in the determination of the individual and the population radiation burden is illustrated. (JSR)

8622 (SZS-157, pp 215-219) DIRECT MEASUREMENT AND ANALYSIS OF GASEOUS AIR CONTAMINATION. Wardaszko, T. Mar 1974.

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

Methods for the direct measurement and analysis of the noble gases (^{41}Ar, ^{85m}Kr, ^{85}Kr, ^{133}Xe, ^{135}Xe) as well as molecular ^{131}I and ^{3}H are discussed. In some cases enrichment may prove necessary in which case the described measuring systems can be used as a final stage in a cycle including enrichment by activated charcoal or similar sorbents. (ERB)

8623 (SZS-157, pp 258-263) PROBE ANALYTICS FOR RADIATION PROTECTION MEASUREMENTS IN THE FEDERAL CENTER FOR RADIATION PROTECTION OF THE DDR. Rehak, W.; Moldenhawer, F. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The place of sample analytics in radiation protection is discussed from the aspect of the four categories of measurements made: measurements on collections (water, plants, food, etc.), control measurements to assure that installations having radioactive materials are maintaining adequate radiation protection standards, measurements made in case of accidents, and measurements to test and prove radiation protection techniques, catastrophic protection, etc. The procedure followed at the Federal Center to fulfill these requirements is outlined. (JSR)

8624 (SZS-157, pp 264-270) ACTIVITY MEASUREMENT METHODS FOR PROBE ANALYTICS OF THE FEDERAL CENTER FOR RADIATION PROTECTION. Herrmann, D.; Obrikat, D.; Rehak, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The development and routine application of numerous activity measurement methods using γ, β, and α measurements is outlined and the minimum detectable activities for many elements are tabulated. (JSR)

8625 TRITIUM CONCENTRATIONS IN AIR AND IN URINE OF WORKERS RESULTING FROM TRITIUM HANDLING. Takiue, M.; Nukazawa, A. (Tokyo Metropolitan Isotope Research Center). Hoken Butsuri; 8: No. 4, 221-227(Dec 1973). (In Japanese).

Tritium content in air and urine of workers was measured during and after the handling of about 30 Ci tritium. Tritium content in environmental samples such as air and air-condensed water collected by a cold trap method was determined using a tritium monitor or a liquid scintillation counter. Internal radiation dose was estimated for workers by the analysis of their urine. The tritium concentration in air was about 10^{-9} μCi/cm^3 at the beginning of work, whereas the maximum value was observed during the working period as 2.6×10^{-4} μCi/cm^3 in hood, 1.3×10^{-6} μCi/cm^3 in laboratory and 1.8×10^{-7} μCi/cm^3 in corridor. The daily urinary excretion of tritium was represented approximately by a single exponential function with the effective half-lives of 14 days and 12 days for two workers, and their internal radiation dose was estimated as 12 mrem and 7.1 mrem respectively. (auth)

8626 VARIATIONS OF NATURAL RADIOCARBON DURING THE LAST 11 MILLENIA AND GEOPHYSICAL MECHANISM FOR PRODUCING THEM. Yang, A. I. C.; Fairhall, A. W. (Univ. of Washington, Seattle). pp A44-A57 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Earlier work by Buddemeier, a radiocarbon study of the varved marine sediments of Saanich Inlet, British Columbia, has been extended to the bottom of the basin, which corresponds to a radiocarbon age of approximately 11,000 years ago. In addition, several tons of datable terrestrial material were also found embedded in the sediment. The ^{14}C activities of sedimentary organic carbon and terrestrial samples provide information on long-term ^{14}C variations in Saanich Inlet water and atmosphere, respectively. The measured ^{14}C variations in the atmosphere (terrestrial samples) agree well with the tree ring data over the past 6,100 y. Between 8,500 and 6,100 y B. P. the atmospheric ^{14}C activity increased from 60 to 100‰. Prior to 8,500 years, it is predicted to continue its downward trend on the basis of Saanich Inlet water activity. On the other hand, the sediment (oceanic) ^{14}C variations have a similar trend as the atmosphere except the former has slightly lower amplitude and lags behind the latter several hundred years. Model calculation suggests that the earth's geomagnetic dipole moment alone accounts fairly well for the observed amplitude of ^{14}C variations both in the atmosphere and in the ocean for the last 6,000 y. However, for the period between 6,000 and 11,000 y B. P., geomagnetic field changes alone can not explain the observed order of magnitude; climatic factors have to be taken into account to give a satisfactory explanation. Sensitivity of ^{14}C variations in the air reservoir to the assumed residence times of ^{14}C is only second order magnitude (compared with the geomagnetic effect). (auth)

8627 CYCLIC SOLUTION FOR THE RELATIONSHIP BETWEEN MAGNETIC AND ATMOSPHERIC ^{14}C CHANGES. Ralph, E. K. (Univ. of Pennsylvania, Philadelphia). pp A76-A84 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

A cyclic, rather than exponential, solution to an equation proposed by Elsasser, Ney, and Winckler relating the effect of changes in the earth's magnetic field upon the rate of production of ^{14}C is presented. From the archaeometric data of Bucha and others the boundary conditions for the solution are found— in particular for the magnitude and duration of the measured magnetic cycle. The calculations show that for a period of 9000 y, the magnetic effect upon the atmospheric inventory of ^{14}C is of the order of 4% with a lag of about 250 y. As this is about half of the known changes in ^{14}C contents 7000 y ago, it is proposed that the changes in magnetic intensity are not the sole cause of changes in atmospheric ^{14}C contents, and that recent pole reversals might have contributed an effect upon the changes. (auth)

8628 ^{14}C INVESTIGATIONS ON SURFACE SEDIMENTS AND MAKROBENTHOS IN THE WESTERN BALTIC SEA. Willkomm, H.; Erlenkeuser, H. (Univ., Kiel). pp C56-C62 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

For getting reliable recent values for dating sea sediments, surface sediments in the western Baltic Sea were investigated. ^{14}C activity of 1 cm layers was measured up to 30 cm depth. Values lie between 98 and 84% of standard recent activity. Perhaps being disturbed by drag-nets they do not show a clear dependence on depth. ^{14}C content of water and makrobenthos ranges from 100 to 140%. There are significant differences in water activity owing to exchange with the North Sea dependent on wind direction, and in the activity of shells corresponding to living habits. (auth)

8629 FURTHER CALCULATIONS ON THE ^{14}C EXCHANGE BETWEEN THE OCEAN AND THE ATMOSPHERE. Gulliksen, S.; Nydal, R.; Lovseth, K. (Norwegian Inst. of Tech., Trondheim, Norway). pp C63-C72 of Proceedings of the Eighth International

Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Continued observations of ^{14}C in ocean surface water have given additional information about the mixed layer response on tropospheric excess activity. Calculations are essentially based on variation of coefficients in exponential functions to make them fit troposphere and mixed layer data. The obtained residence times for mixed layer exchange with troposphere, τ_{mt}, and deep ocean τ_{md}, are ranging from 7.1 to 9.1 y and from 2.8 to 4.3 y, respectively. (auth)

8630 ^{14}C MEASUREMENTS ON WATER, PLANTS, AND SEDIMENTS OF LAKES. Willkomm, H.; Erlenkeuser, H. (Univ., Kiel). pp D1-D12 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

The hard water effect of 22 lakes lies between 0 and 1600 y. It is shown by measuring recent samples marked by the atomic bomb effect that the ^{14}C activity of aqueous plants is in equilibrium to water activity, and that a delay time of a few years lies between atmosphere and water and between water and surface sediment. In volcanic regions, the hard water effect is enlarged by magmatic CO_2. A correlation to δC^{13} values found in old sediments could not be confirmed by measurement of recent aqueous plants. (auth)

8631 BUILDING MATERIALS AND FILM FOGGING. Lundh, A. (Ceaverken AB, Straengnaes, Sweden). Brit. J. Non-Destruct. Test.; 16: No. 6, 174-178(Nov 1974).

All photographic film increases in fog density during storage, by integrating the natural background radiation. This background radiation depends strongly on the material of the storage building and in this article different building materials and methods of building are compared. The background radiation level should not exceed 10 μR/h; cold storage is unnecessary but the room temperature should not exceed 20°C. (auth)

8632 DATA. Section IV. Other Data. Radiat. Data Rep.; 15: No. 11, 723-756(Nov 1974).

Data are presented on environmental levels of radioactivity at the Lawrence Livermore Laboratory at Livermore, California, and at the National Reactor Testing Station at Idaho Falls, Idaho. In both cases, the data represent monitoring activities during 1972. All data are presented in tabular form. (ERB)

Atmosphere

Refer also to abstract 8203.

8633 (SZS-157, pp 208-214) MEASUREMENTS ON THE POLLUTION OF THE ATMOSPHERE BY ^{85}Kr. Csongor, E. (Inst. of Nuclear Research, Debrecen, Hungary). Mar 1974.

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The ^{85}Kr content of the atmosphere in France, West Germany, Japan, and North America in recent years (1954 to 1971) was determined. The results confirm the fact that the origin of the ^{85}Kr in the atmosphere is the nuclear industry, not nuclear weapons tests. The present concentration of ^{85}Kr results in a dose of about 0.03 mrem/year. The dose in 2060 AD is projected at 50-100 mrem/year. Thus the desirability and necessity of developing techniques for removing ^{85}Kr from fuel reprocessing off-gases can be seen. (ERB)

8634 (SZS-157, pp 220-229) INVESTIGATION OF THE CONTAMINATION OF THE ATMOSPHERE BY USE OF AN IONIZING RADIATION SPECTROMETER. Yagelyak, Ya.; Gvyazdovski, B. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The use of spectrometric methods for the determination of air contamination is discussed. The sampling methods used in order to obtain samples whose α and γ spectra can be used for the evaluation of the natural and artificial radioisotopes in the air are discussed. A spectrometric installation designed for this purpose with scintillation detectors and pulse chambers is described. Methods for studying the nonradioactive pollution of the air by neutron activation analysis and x-ray fluorescence are discussed. The spectrometric device with Ge(Li) and Si(Li) detectors used for this purpose is described. (tr-auth)

8635 ATMOSPHERIC PRESSURE EFFECTS ON ^{222}Rn TRANSPORT ACROSS THE EARTH—AIR INTERFACE. Clements, W.E.; Wilkening, M.H. (Department of Physics, New Mexico Institute of Mining and Technology, Socorro, New Mexico 87801). J. Geophys. Res. 79: No. 33, 4865-4870 (20 Nov 1974).

The effect of large—scale atmospheric pressure changes on the ^{222}Rn flux across the soil—air interface is investigated. Field data collected during 1972 and 1973 show that pressure changes of 1—2% associated with the passage of frontal systems produce changes in the ^{222}Rn flux from 20 to 60%, depending upon the rate of change of pressure and its duration. A simple model of molecular diffusion combined with pressure—induced transport in the soil has been confirmed by laboratory experiments using a vertical column of ^{226}Ra—bearing sand. On the basis of this model, pressure changes of 10—20 mbar occurring over a period of 1—2 days produce Darcy velocities of the order of 10^{-4} cm s^{-1} near the surface of a soil having a permeability of 10^{-8} cm^2. The corresponding variations in the ^{222}Rn flux predicted by the model are in agreement with those observed from valley alluvium in central New Mexico. (auth)

8636 ORIGIN OF ^{222}Rn AND ITS LONG—LIVED DAUGHTERS IN AIR OVER HAWAII. Moore, H.E.; Poet, S.E.; Martell, E.A. (National Center for Atmospheric Research, Boulder, Colorado 80302); Wilkening, M.H. J. Geophys. Res. 79: No. 33, 4859-4864 (20 Nov 1974).

Concentrations of ^{222}Rn, ^{210}Pb, ^{210}Bi, ^{210}Po, and ^{90}Sr were determined in surface air on the windward side of Hawaii. About three fourths of the ^{222}Rn on the lower slopes of the island is due to emanation from the island surface, whereas the remainder of the ^{222}Rn and most of its long—lived radioactive daughters, ^{210}Pb, ^{210}Bi, and ^{210}Po, are advected from distant continental sources. The transient time of air masses over the island, the transit time from distant continental regions, and the mean aerosol residence times above and below the trade wind inversion are estimated to be about 13 hours, 15—20 days, and 5 and 2 days, respectively. (auth)

8637 WORLD-WIDE CONTAMINATION OF THE ATMOSPHERE WITH ^{85}Kr FROM PEACEFUL USES OF NUCLEAR ENERGY. Karol, I. L.; Ivanov, V. I.; Kolobashkin, V. M.; Leipunskii, O. I.; Nedrasov, V. I. Tr., Inst. Eksp. Meteorol.; 1: No. 32, 27-40(1972). (In Russian).

The mean annual and mean zonal concentration of ^{85}Kr from emissions of nuclear power plants were calculated for the world-wide troposphere and the lower stratosphere with numerical integration of model equations of planetary transfer for continuous surface sources in the temperate latitudes. A comparison was made of the calculated and measured values of the concentration of the isotope in the ground level atmosphere, primarily for the temperate latitudes of the northern hemisphere. Differences in the levels of the calculated concentration were noted in the northern and southern hemispheres. The expected world-wide distribution of the concentration of ^{85}Kr from peaceful uses of nuclear energy up to the year 2000 was discussed. (tr-auth)

8638 DESIGNING A NETWORK OF STATIONS FOR MEASUREMENT OF THE CHEMICAL PROPERTIES OF ATMOSPHERIC FALLOUT. Karol, I. L.; Myach, L. T. Tr., Inst. Eksp. Meteorol.; 1: No. 32, 98-110(1972). (In Russian).

The data from the measurement of the chemical composition of fallout from 1958 to 1965 at 28 stations was used for the calculation of the correlation function of concentration in fallout and precipitation of the ions Ca^{2+}, Na^+, and SO_4^{2-} and the sum of the ions. The correlation radii for the different ions varies from 90 to 450 km. From the calculated correlation functions the order of magnitude of the mean square random errors of the measurement of the ion concentration (35 to 45%) was evaluated. The errors of the optimum interpolation for concentration values and errors of the optimum averaging for the precipitation values were calculated. It was shown that for concentration of the ion sum the interpolation error, equal to the random observation error, was reached at average distances between stations of the order of 100 km. Optimum averaging of such errors can be obtained by the presence of 2 to 3 stations in square areas of 300 × 300 km^2. (tr-auth)

8639 MONITORING OF FALLOUT IN ZAGREB. Bauman, A.; Franic, N.; Popovic, V. (Inst. for Medical Research and Occupational Health, Zagreb). Arh. Hig. Rada Toksikol.; 25: No. 2, 197-200(1974). (In Slovak).

From symposium on chemistry and environment; Zagreb, Yugoslavia (16 Feb 1973).

For the last 12 years the radioactive contamination of the rain was monitored within a larger environmental survey. Beta and gamma activity control was included. Data are presented on variations in radioactivity due to the time elapsed since the last nuclear explosion. (auth)

8640 DISTRIBUTION OF THE CONCENTRATION OF RADON, ATMOSPHERIC DUSTS, AND FISSION PRODUCTS IN THE MOVING AIR CURRENTS OVER THE ATLANTIC OCEAN AS A FUNCTION OF THE LOCATION OF THE INTRATROPICAL CONVERGENCE ZONES. Belen'kii, V. S.; Krasnopevtsev, Yu. V.; Malakhov, S. G. Tr., Inst. Eksp. Meteorol.; 1: No. 32, 40-45(1972). (In Russian).

Data from the measurement of the concentration of the decay products of radon, the total of the active decay products, and dusts in the moving air currents made on the ship "Akademik Shirshov" in April and May 1970 in the Atlantic Ocean were reported. During the passage of the ship through intratropical convergence zones the concentrations of dusts and fission products changed sharply, sometimes by more than an order of magnitude. The change of the concentration of radon decay products was very smooth. Hypotheses were derived on the use of the measurement of radon decay products, dusts, and fission products from explosions for the determination of the location of intratropical convergence zones. (tr-auth)

8641 ^{85}Kr ACTIVITY IN THE ATMOSPHERE OF THE NORTHERN AND SOUTHERN HEMISPHERES. Farges, L.; Patti, F.; Gros, R.; Burgeon, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). J. Radioanal. Chem.; 22: No. 1-2, 147-155(1974). (In French).

The evolution of ^{85}Kr concentrations in the atmosphere was followed in the Northern hemisphere from June 1966 to May 1972 and in the Southern hemisphere from March 1968 to June 1971. Results for the Northern hemisphere could be compared with those of other authors. A short description of the analytical method used is given. (auth)

8642 16TH REPORT OF THE FEDERAL COMMISSION ON THE MONITORING OF RADIOACTIVITY FOR THE YEAR 1972, FOR THE ATTENTION OF THE FEDERAL COUNCIL. Huber, O.; Halter, J.; Winiger, P. Bull. Eidgenoess. Gesundh., Beil. B; 22: No. 3, 137-235(Sep 1973). (In German).

The results of the radioactivity monitoring carried out in 1972 are presented in graphs and tables. Results are reported on the radioactivity of the air, precipitation, surface and underground water, waste water, soil, plants, milk, drinking water, cereals, bread, and other foods and ^{90}Sr and ^{137}Cs contamination of the human body. (JSR)

8643 ^{14}C MEASUREMENTS IN THE ATMOSPHERE AND IN THE SOUTH PACIFIC OCEAN. A Recalculation of the Exchange Rates Between the Atmosphere and the Ocean. Rafter, T. A.; O'Brien, B. J. (Inst. of Nuclear Sciences, Lower Hutt, New Zealand). pp C17-C42 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Further measurements of the ^{14}C activities of atmospheric carbon dioxide and of bicarbonate in the surface water collected in the South Pacific are presented. The ^{14}C activity of the carbon dioxide in both hemispheres is now virtually the same. Over the last three years there has been a definite slowing down in the rate of decrease of the ^{14}C activity of the atmosphere. A decrease in the ^{14}C activity of the surface water collected at Makara, New Zealand is being observed. Carbon-14 activities of surface water collected at a number of South Pacific ocean stations show an increase of about 14% since 1958. ^{14}C activity measurements in the atmosphere and the surface of the ocean have been used to estimate exchange times between the surface ocean and the deep ocean. The latter exchange time appears to be much shorter than previously estimated. (auth)

8644 DEPOSITION OF STRONTIUM-90 IN THE SOUTHERN HEMISPHERE AND ITS RELATION TO PRECIPITATION. Deland, R. J. (New York Univ., N. Y. (USA). Research Div.). Arch. Meteorol., Geophys. Bioklimatol., Ser. B; 21: No. 2;3, 255-268(1973).

The relationship of monthly ^{90}Sr deposition in middle latitudes of the Southern Hemisphere to precipitation was analyzed, showing that the deposition increases approximately as the square root of precipitation. Evidence is presented that the seasonal variation of deposition at a given station is modified by the annual variation of rainfall. Based on this evidence, the reported depositions were corrected for rainfall, and the resulting normalized depositions were used to analyze the annual cycle and long-term decrease of deposition after testing of nuclear weapons. The results indicate that the amplitude of the annual variation of deposition in the Southern Hemisphere is similar to that in the Northern Hemisphere, but of somewhat smaller amplitude. The rate of decrease of deposition, and the inferred rate of depletion of the stratospheric reservoir in the absence of fresh injections, are shown to correspond to a "half-life" of about ten months, in agreement with the results of studies of the rate of decrease of the stratospheric burden. (auth)

8645 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 15: No. 10, 672-681(Oct 1974).

The following data are presented from the Environmental Radiation Ambient Monitoring System; gross β radioactivity in surface air and precipitation at selected sites in the USA and its territories during May 1974 and the plutonium and uranium concentrations in surface air at selected sites in the USA during October to December 1973. Data are also presented on the gross β radioactivity in air and precipitation at selected sites along the NERC-LV, Canadian, Pan American and Californian air sampling networks during May 1974. (ERB)

8646 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 15: No. 11, 708-722(Nov 1974).

The following data are presented from the Environmental Radiation Ambient Monitoring System; gross β radioactivity in surface air and precipitation at selected US sites during June 1974; plutonium and uranium concentrations in surface air at selected US sites during January to March 1974; and krypton-85 content in surface air at selected US sites during January to June 1973. Data are also presented on the gross β radioactivity in air and precipitation during June 1974 as reported by the National Environmental Research Center-Las Vegas, Canadian, Pan American, Californian, and Mexican sampling networks. (ERB)

8647 ATMOSPHERIC RADON AND CONTINENTAL DUST NEAR THE ANTARCTIC AND THEIR CORRELATION WITH AIR MASS TRAJECTORIES COMPUTED FROM NIMBUS 5 SATELLITE PHOTOGRAPHS. Wilkniss, P. E.; Larson, R. E.; Bressan, D. J. (Naval Research Laboratory, Washington, DC). J. Appl. Meteorol.; 13: 512-515(1974).

Soil

Refer also to abstracts 8606 and 8976.

8648 (ARH-SA-176) AERIAL GAMMA SURVEY BY HELICOPTER TO MEASURE SURFICIAL CONTAMINATION. Bruns, L. E. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Mar 1974. Contract AT(45-1)-2130. 18p. (CONF-740921-20). Dep. NTIS $4.00.

From atmosphere-surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

A development project was carried out to determine whether aerial γ surveys could adequately measure the activity of high specific activity γ emitters contaminating large surface areas. The survey successfully measured the ^{137}Cs activity and the total gross γ over areas from less than one square kilometer to 20 square kilometers. Also ^{241}Am was successfully measured over areas wherein the ^{137}Cs was sufficiently low. Microcuries per square meter were measured as low as 0.1 for ^{137}Cs and ^{241}Am. Other radionuclides such as ^{60}Co were also detected. An aerial neutron survey was tried though its efficiency limited detection to areas having more than ten kilograms Pu per 4,000 square meters. The aerial survey can analyze a complete area thereby saving millions of dollars in statistical sampling and analytical programs. (auth)

8649 RADIOCARBON DATING IN STUDIES OF SOIL ORGANIC MATTER-VEGETATION RELATIONSHIPS. Tate, K. R. (Soil Bureau, Lower Hutt, New Zealand). pp E27-E38 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand(1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

Radiocarbon dates of topsoil and subsoil humic acids from a New Zealand yellow-brown earth at a pasture and a forest site have been used to evaluate humic acid hydrolysis techniques in studies of soil organic matter-vegetation relationships. Identification of charcoal from the topsoil under an introduced pasture has shown that the pasture site was originally covered with a forest composed largely of hard beech (Nothofagus truncata). Measurements have been made of the enrichment by atmospheric radiocarbon of the whole soils and of the humic acids extracted from these soils. These experiments have indicated that ^{14}C enrichment was principally restricted to the topsoil under the pasture of ryegrass (Lolium perenne) and white clover (Trifolium repens), but occurred throughout the profile under hard beech. The humic acids from the topsoils and subsoils were hydrolysed with hydrochloric acid. The ratio of the vanillic acid to p-hydroxybenzoic acid in the acid hydrolysates decreased down the soil profile under hard beech, but markedly increased down the profile under pasture. The hydrolysis data suggest that the organic matter in the pasture subsoil still retained the imprint of the former forest vegetation. These results are consistent with the radiocarbon measurements, and confirm the value of the acid hydrolysis technique in soil organic matter-vegetation studies. (auth)

8650 RADIOCARBON ENRICHMENT AND THE TURNOVER OF SOIL ORGANIC MATTER IN A CHRONOSEQUENCE OF SOILS DEVELOPED ON WIND-BLOWN SAND IN NEW ZEALAND. Goh, K. M. (Lincoln Coll., Canterbury, Australia); Stout, J. D. pp E67-E79 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

The degree of radiocarbon enrichment in the various members of a soil chronosequence was studied to determine the extent of bomb-produced ^{14}C-incorporation with time (soil age), and the possible pathways of humus formation, and to provide information on the rates of turnover of soil organic matter. The following results were obtained: ^{14}C-enrichment of soil organic matter occurred mainly in topsoils and decreased with increasing soil age; ^{14}C-enrichment was higher in pasture top soils than in forest topsoils; organic matter continues to accumulate even in soils more than 10,000 years old and an equilibrium is never reached; and, although there is a minimum influence of bomb- ^{14}C in the subsoils, the subsoil organic matter is subjected to a slow but continuous incorporation of ^{14}C from the atmosphere via plant residues. (LCL)

8651 ZIRCONIUM CONCENTRATIONS AND INITIAL STRONTIUM-87/STRONTIUM-86 RATIOS, KIRKPATRICK BASALT, STORM PEAK, QUEEN ALEXANDRA RANGE. Faure, G.; Owen, L. B.; Bowman, J. R.; Elliot, D. H. (Ohio State Univ.). Antarct. J. U. S.; 9: No. 5, 239-241(1974).

The results of x-ray fluorescence analysis of samples of basalts from Storm Peak, Queen Alexandra Range in Antarctica for determination of Zr content are reported and correlated with measurements of the $^{87}Sr/^{86}Sr$ ratios of the samples. The strong correlation found suggests contamination of a basaltic magma with material having a high $^{87}Sr/^{86}Sr$ ratio and high zirconium concentration. (LCL)

Water

8652 (SZS-157, pp 33-37) JUSTIFICATION OF THE HYGIENE STANDARD PERMISSIBLE CONCENTRATIONS OF ^{232}Th AND NATURAL Th IN DRINKING WATER. Lyarskii, P. P.; Pavlovskaya, N. A.; Petushkov, A. A.; Zel'tser, M. R.; Provotorov, A. V.; Makeeva, L. G. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

An attempt was made to make more precise the parameters determining the accumulation of Th isotopes and their decay products and on the basis of the results obtained and literature data to calculate the maximum permissible concentration for ^{232}Th and natural Th in drinking water. (JSR)

8653 UPTAKE OF PLUTONIUM, RUTHENIUM, AND TECHNETIUM BY PHYTOPLANKTON. Gromov, V. V.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Dokl. Biol. Sci.; 215: No. 1-6, 147-150(1974).

Translated from Dokl. Akad. Nauk SSSR; 215: No. 1, 214-217 (Mar 1974).

The results of an investigation of the absorption of ^{239}Pu, ^{106}Ru, and ^{99}Tc by a culture of single-cell green algae, Platymonas viridis, and by a natural community of phytoplankton are presented. It was found that the natural phytoplankton community takes up all three radioisotopes to a greater extent than the pure culture did. At 15 to 17 days, the isotopes are released into the seawater in a physico-chemical form in equilibrium with the oceanic environment. This may be a decisive factor in the migration of these radioisotopes in the ocean. (ERB)

8654 INFLUENCE OF PHYTOPLANKTON ON THE PHYSICOCHEMICAL STATE OF ^{239}Pu, ^{106}Ru, ^{99}Tc, AND ^{60}Co IN SEA WATER. Gromov, V. V.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Dokl. Biol. Sci.; 215: No. 1-6, 151-153(1974).

Translated from Dokl. Akad. Nauk SSSR; 215: No. 2, 451-453 (Mar 1974).

The change in the physicochemical state of ^{239}Pu, ^{106}Ru, ^{99}Tc, and ^{60}Co due to their assimilation by phytoplankton was investigated. It was found that biological assimilation by phytoplankton is decisively important in the stabilization of physicochemical forms of these radioisotopes, as a result of which the state of Pu, Ru, Tc, and Co in the marine environment is altered, which in turn leads to variation in the entrapment of these elements by bottom sediment and, evidently, by suspended matter. (ERB)

8655 RADIOCARBON IN THE SEA. Fairhall, A. W.; Young, A. W.; Bradford, P. A. (Univ. of Washington, Seattle). pp C2-C16 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Beginning in 1963, the radiocarbon produced in the 1961-62 nuclear tests by the USSR and the USA has been traced by periodically monitoring the atmosphere and a number of stations in the oceans. In the decade since these tests the atmospheric inventory of excess (i.e. bomb-produced) ^{14}C has declined from a value of about 5×10^{28} ^{14}C atoms to less than 1.6×10^{28} ^{14}C atoms. Most (ca.0.8) of this excess ^{14}C has been transferred to the oceans. Including the excess ^{14}C from earlier nuclear testing, the world average uptake of excess ^{14}C by the oceans is about 10^{14} ^{14}C atoms/m^2 sea surface. Measurements of ^{14}C specific activity and total dissolved inorganic carbon in sea-water allows the absolute concentration of ^{14}C in sea water to be determined. The data indicate that natural ^{14}C concentrations in much of the southern ocean was $1.42 \pm 0.02 \times 10^9$ ^{14}C atoms/litre, independent of depth or location. Radioactive decay was presumably balanced by dissolution of fresh organic matter raining down from the surface. The North Pacific Ocean shows somewhat lower concentrations, ca.$1.37 \pm 0.02 \times 10^9$ ^{14}C atoms/litre, nearly independent of depth at two locations in the tropical Pacific and in the north-western Pacific. In the north-eastern Pacific the natural ^{14}C concentrations appear to increase to a maximum of about 1.5×10^9 ^{14}C atoms/litre at 200 m depth. At one station at high latitude in the North Atlantic an upper limit of 1.47×10^9 ^{14}C atoms/litre of natural ^{14}C, independent of depth, is indicated. Bomb ^{14}C can be recognized at all depths at this station, from a minimum of 6% increase in the bottom samples to 11% in near surface samples. The integrated excess ^{14}C ranges from about 0.3×10^{14} ^{14}C atoms/m^2 to the northeast Pacific to 4×10^{14} ^{14}C atoms/m^2 for the North Atlantic. (auth)

8656 RADIOCARBON IN THE SURFACE WATERS OF THE ATLANTIC OCEAN. Vogel, J. C. (National Physical Research Lab., Pretoria). pp C43-C55 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Evidence is presented that too low values for the ^{14}C content of sea water are obtained from samples stored for two months in plastic containers without the addition of a preservative. It is, therefore, important that the inorganic carbon be extracted directly after sampling. Samples collected in the eastern Atlantic Ocean between 1967 and 1970 show that the ^{14}C content of the surface waters is relatively homogeneous over wide areas, but that low values occur in areas of upwelling and that water masses with higher values exist in some regions. The limited number of samples suggests that the increase in radiocarbon content is not taking place at a steady rate and that a simple box model of the ocean does not apply on a timescale of one or two years. Nevertheless, the slow decrease in the excess ^{14}C in the atmosphere of the southern hemisphere can be used to predict the rate of increase in the surface ocean water. Comparison with the existing data allows the residence time of water in the mixed layer of the South Atlantic to be estimated as longer than 10 years. (auth)

8657 BOMB PRODUCED RADIOCARBON IN THE SURFACE WATER OF THE PACIFIC OCEAN. Linick, T. W.; Suess, H. E. (Univ. of California, San Diego, La Jolla). pp C87-C93 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

The radiocarbon content of the bicarbonate in approximately 250 samples of surface ocean water taken at various locations in the Pacific Ocean over the period from 1958 until 1971 have been determined. The rise due to the uptake of bomb produced radiocarbon from the atmosphere was fastest in intermediate latitudes around 28° North and 28° South, and in 1969 and 1970 reached values of approximately 25% above pre-bomb times. The rise along the equator was approximately half as great and was still smaller at high southern latitudes. (auth)

8658 ENVIRONMENTAL MONITORING AND DISPOSAL OF RADIOACTIVE WASTES FROM U. S. NAVAL NUCLEAR-POWERED SHIPS AND THEIR SUPPORT FACILITIES, 1973. Miles, M. E.; Sjoblom, L. G.; Eagles, J. D. Radiat. Data Rep.; 15: No. 10, 625-646(Oct 1974).

The environmental effect of disposal of radioactive wastes originating from U. S. Naval nuclear propulsion plants and their support facilities is assessed. The total radioactivity, less tritium discharged to all ports and harbors from the more than 100 Naval nuclear-powered ships and supporting tenders, Naval bases and shipyards was less than 0.002 curie in 1973. The total tritium released to all ports and harbors was less than 1 curie in 1973. This report confirms that procedures used by the Navy to control releases of radioactivity from U. S. Naval nuclear-powered ships and their support facilities are effective in protecting the environment and the health and safety of the general public. (auth)

8659 DATA. Section II. Water. Radiat. Data Rep.; 15: No. 10, 667-671 (Oct 1974).

Data are presented on the radioactivity in surface waters in the state of Washington. Beta and gamma radioactivity were measured at selected sites throughout the state and monthly averages are presented for the period between July 1971 and June 1972. All data are presented in tabular form. (ERB)

8660 DATA. Section II. Water. Radiat. Data Rep.; 15: No. 11, 707 (Nov 1974).

Federal Radiation Council recommendations for drinking water supplies are given and the various water sampling programs from which data were previously published are listed. No new data are presented. (ERB)

8661 TRITIUM AND MERCURY RESULTS FROM ELTANIN CRUISE 51. Williams, P. M. (Univ. of California, San Diego, La Jolla); Michel, R.; Weiss, H. Antarct. J. U. S.; 9: No. 5, 221-222 (1974).

Seawater, ice pack, and sediment samples collected on USNS Eltanin cruise 51 (Feb. to Mar. 1972) from Port Lyttleton, N. Z. to McMurdo Station, Antarctica were analyzed for their ^{3}H and total mercury contents. The high ^{3}H concentration found in pack ice and in water samples to depths of 125 m reflected the introduction of ^{3}H from 1971 precipitation on pack ice and the subsequent melting of the pack ice and mixing into antarctic surface water. Analyses of ice packs, water to depths of 4892 m, and sediments showed no significant differences in Hg content between surface and deep waters. However, the total Hg content in the south polar seas was 2 to 3 times that found in the northeast Pacific. These high concentrations may be the result of submarine volcanism in the area. Low Hg contents (8 to 34 ngg^{-1}, dry weight basis) were found in sediment cores. (LCL)

Ecosystems and Food Cycles

Refer also to abstracts 8949 and 8984.

8662 (SZS-157, pp 138-141) ACTIVITIES RELATED TO THE MEASUREMENT OF RADIOACTIVE SUBSTANCES IN FOOD AT HUNGARY. Kovacs, J.; Nedelkovits, J. (Institut fuer Lebensmitteluntersuchung, Budapest). Mar 1974.

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The ^{137}Cs and ^{90}Sr contents of certain Hungarian food products (vegetables, milk, animal bones, and fish) were determined. Methods of monitoring and analysis are discussed. Over a 10-year period, the radioactive contamination showed significant differences as a function of time. When compared with gross activity, the man-made radioactivity was very low. (ERB)

8663 (SZS-157, pp 142-144) INVESTIGATION OF RADIOACTIVE CONTAMINATION IN FOODSTUFFS OF PLANT ORIGIN. Liszonyi, M.; Kovacs, J.; Kiss, B. (Institut fuer Lebensmitteluntersuchung, Budapest). Mar 1974.

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The ^{40}K and ^{90}Sr content of Hungarian vegetables was determined. Methods of monitoring and analysis are discussed. The radioactive contamination data of vegetables showed a similar tendency as the fallout and surface water activity. No significant difference as a function of sampling area was determined. Higher activities in some parts of Hungary during the sampling period (10 years) are explained on the basis of the fact that rainfall influenced significantly the activity measured at a definite time. (ERB)

8664 (SZS-157, pp 145-150) INVESTIGATION OF RADIOACTIVE CONTAMINATION IN FOODSTUFFS OF ANIMAL ORIGIN. Kiss, B.; Liszonyi, M.; Kovacs, J. (Institut fuer Lebensmitteluntersuchung, Budapest). Mar 1974.

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The ^{137}Cs and ^{90}Sr contents of Hungarian animal products (cattle and sheep bones, fishes, and milk) were determined. Methods of radiation monitoring and analysis are discussed. Samples of animal origin were not as sensitive to changes of environmental contamination as products of plant origin. This fact could be explained by the capability of animal organs for discrimination. The data showed rather large fluctuations in products of animal origin, first of all in milk. (ERB)

8665 (TID-26674) RADIOACTIVITY STUDIES. (Academy of Natural Sciences of Philadelphia, Pa. (USA). Dept. of Limnology). Jan 1962. 15p. Dep. NTIS $4.00.

For Savannah River Plant, Aiken, SC.

The data indicate that radiostrontium ^{89}Sr, ^{90}Sr-^{90}Y) was not bound significantly by the mud, sand, silt, or organic matter in the Lower Three Runs stream bed. Significant concentrations of radiostrontium were found only in the bones or shells of fish, mollusks, and crustaceans. The radiostrontium concentrations in the fleshy tissues of all aquatic specimens were at or below the sensitivity of analysis, indicating little, if any, metabolic buildup of radiostrontium. Significant concentrations of radiocesium ^{137}Cs were bound to the substrate samples, aquatic plants, insects, fish, mollusks, and crustaceans. Low level concentrations of radiocesium were generally found in both the bones and flesh of aquatic specimens. The data show that radiozinc (^{65}Zn) was the primary isotope present in both the bones and flesh of Steel Creek fish. Radiocesium (^{137}Cs) and radiostrontium (^{90}Sr, ^{90}Sr-Y) were the secondary isotopes in the flesh and bones, respectively. The single substrate sample contained trace concentrations of only ^{137}Cs and ^{65}Zn. (auth)

8666 CARBON ISOTOPE FRACTIONATION BY PLANTS. Troughton, J. H. (Physics and Engineering Lab., Lower Hutt, New Zealand). pp E39-E57 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

There is a pronounced bimodal distribution of δ^{13}C values among a wide range of genera in both monocotyledonous and dicotyledonous plants. One group of plants has a mean δ^{13}C value of $-14^{0}/_{00}$ and the other group a mean value of about $-27^{0}/_{00}$. The cause of the differences in δ^{13}C values between the two groups can be directly related to processes involving CO_2 exchange; plants with the C_4 pathway of photosynthesis occur in the group with the less negative δ^{13}C values while C_3 type plants occur in the other group. Differences between the two groups may be due to the enzyme involved in the primary photosynthetic carboxylation reaction, the carboxylating species, photorespiration and diffusion of CO_2 into the plant. Variation between plants within each group may be due to genetic differences or environmental effects. Although the processes likely to cause fractionation of carbon by plants can be identified, the relative magnitude and importance of these steps in different plants has yet to be established. (auth)

8667 FUTURE CO_2 BURDEN OF THE ATMOSPHERE AND ^{14}C IN THE ETHANOL FROM WINES. Zimen, K. E. (Hahn-Meitner Inst., Berlin). pp A85-A96 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Scintillation measurements of purified ethanol from wines + toluol (2 + 3) allow rapid analyses of the ^{14}C content with good reproducibility. As suitable wine samples (no sugar added) with known ages are readily available for at least the past two decades one is able to reconstruct the ^{14}C burden of the atmosphere in different places of the globe during these years. By studying the exchange kinetics of the ^{14}C between the atmosphere and the other reservoirs, mainly the ocean, one should possibly be able to arrive at estimations of the atmospheric CO_2 excess in the future. The results of measurements of German and Australian wines from 1954 to 1971 will be reported. (auth)

8668 BEHAVIOR AND DISTRIBUTION OF RADIOACTIVE RUTHENIUM IN THE FRESHWATER ENVIRONMENT. Role of Food Chains. Koga, T. (Kinki Univ., Osaka); Tsukada, S.; Honda, Y. Kinki Daigaku Genshiryoku Kenkyusho Nenpo; 10: 5-16 ([nd]). (In Japanese).

The role of food chains in the uptake, accumulation, and loss of radioactive ruthenium (^{106}Ru-nitro and -nitrato complexes) by freshwater organisms (freshwater mussels and crucian carps) was studied in the aquarium ecosystems that contained Chlorella or duckweeds (in crucian carp only) as the food organisms. The following results were obtained. In the uptake of ^{106}Ru by freshwater mussels, the apparent equilibrium state was attained more rapidly in the ingestion of contaminated food than in the control system (no feeding), and also the distribution of ^{106}Ru in soft tissues and the concentration factors for ^{106}Ru in gill and muscle at the equilibrium state were somewhat higher in feeding on the contaminated food than in the control. The velocity of uptake of ^{106}Ru and the accumulation of the radionuclide seemed to depend on the size of the mussel. In the uptake of ^{106}Ru by crucian carp, the concentration factors in tissues except digestive tracts at the equilibrium state were about one-tenth lower for the group accumulated from radioactive food only than for the group accumulated from both radioactive water and food. The distribution of ^{106}Ru in both skin and gills increased with time and the concentration factor for digestive tract including the contents was higher than that for the other tissues. As for the effects of initial chemical form of ^{106}Ru in rearing water on the uptake of the radionuclide by crucian carps, the concentration factors for ^{106}RuNO-nitrato complexes were about several times higher than that for ^{106}RuNO-nitro complexes. At higher water temperature, the elimination of ^{106}Ru from crucian carp was more rapid and also the long biological half-lived component was much smaller. In the elimination experiments following different uptake routes of ^{106}Ru by crucian carps, the long-lived component for the fish fed on radioactive Chlorella in radioactive rearing water was about three times larger than for the fish reared in radioactive water alone. This result suggests that the metabolic rate of ^{106}Ru by fish may be varied with uptake routes. (auth)

8669 DATA. Section I. Milk and Food. Radiat. Data Rep.; 15: No. 10, 657-666(Oct 1974).

Data are presented on the ^{137}Cs and ^{90}Sr contents in milk from selected sampling stations in the U. S., Canada, and Central and South America. The data represent a monthly average for May 1974 and a 12-month average for the year ending in May 1974. All data are presented in tabular form. (ERB)

8670 DATA. Section I. Milk and Food. Radiat. Data Rep.; 15: No. 11, 697-706(Nov 1974).

The ^{137}Cs and ^{90}Sr contents of milk from selected sampling stations in the United States, Canada, and Central and South America during June 1974 (monthly average) and the twelve-month average for the year ending in June 1974 are presented. (ERB)

8671 RADIONUCLIDES IN FOODS: MONITORING PROGRAM. Simpson, R. E.; Baratta, E. J.; Jelinek, C. F. Radiat. Data Rep.; 15: No. 10, 647-656(Oct 1974).

In January 1973, the Food and Drug Administration notified its food monitoring program to include the radionuclides strontium-90, cesium-137, iodine-131, ruthenium-106, and potassium-40. Samples from eight composite food categories from each of eight separate total diet market baskets plus eight imported commodities from each of 13 separate cities were forwarded to the Winchester Engineering and Analytical Center for analysis. This paper describes the market basket program and gives a breakdown of the types of foods and quantities of each. The radionuclide levels found in the total diets analyzed in Fiscal Year 1973 are within Range I of the appropriate guidelines, indicating the need for continued surveillance only at the present level. The levels of radionuclides found in the limited types of edible imported commodities are low enough such that their contribution to the total diet would not be expected to raise the levels of these radionuclides above Range I of the guides. (auth)

8672 BIOACCUMULATION AND SEASONAL FLUCTUATION OF ^{137}Cs IN VEGETATION FROM THE WAYCROSS STATE FOREST, GEORGIA. Stockbridge, D. L.; Jenkins, J. H. (Univ. of Georgia, Athens). Bull. Ga. Acad. Sci.; 32: No. 3-4, 37-47 (Sep 1974).

This study investigates several of the factors influencing bioaccumulation and seasonal fluctuation in vegetation of the Waycross State Forest, Georgia. The sterile, sandy soils of this area contain few fixing minerals to hold ^{137}Cs in the soil. Therefore, whatever ^{137}Cs is present is usually available for plant uptake. The vegetation of the area generally has persistent foliage which when coupled with the area's long growing season tends to allow more time for ^{137}Cs accumulation. A fertilization study designed to determine if the addition of a potassium fertilizer retards ^{137}Cs uptake by vegetation gave negative results. It is possible that the fertilizer was leached out of the soil before vegetation had time to absorb a significant amount of potassium. Gallberry, waxmyrtle, sweetbay, fern and deer tongue exhibited seasonal fluctuation patterns of ^{137}Cs concentrations with the highest levels occurring during the summer. Mushrooms contained very high ^{137}Cs concentrations and it is quite likely that the mycorrhizal networks associated with these mushrooms play an important part in ^{137}Cs movement through this ecosystem. (auth)

8673 RADIOACTIVE CONTAMINATION OF FRUIT TREES BY FISSION PRODUCTS. V. ^{137}Cs Distribution in Fruit of the Satsuma Orange Trees Grown at an Orchard. Shiraishi, Y. (National Inst. of Radiological Sciences, Chiba, Japan). Hoken Butsuri; 8: No. 4, 209-215(Dec 1973). (In Japanese).

From 1961 through 1971, the distribution of fallout ^{137}Cs in the skin, juice, and residue part of the mature fruit of Satsuma orange trees grown on soils under clean, mulch, and sod systems of soil management was investigated to compare its annual change with that of ^{90}Sr. Due to a great dependency on the fallout rate the level of this nuclide in each of the fruit parts showed a high concentration during the period of heavy fallout deposition followed by a sharp decrease. After this, a slow exponential decrease was observed with almost the same half-time as that of the replaceable ^{137}Cs content in soil during the period of very little fallout deposition. The ratio of the ^{137}Cs contribution due to direct (surface) absorption, root absorption, and translocation from leaves was 95 : 4 : 1 for skin, 44 : 45 : 11 for juice and 34 : 53 : 13 for residue in 1963 with heavy fallout deposition. The ratio of ^{137}Cs/K in plant tissues to replaceable ^{137}Cs/K in soil and the ratio of ^{137}Cs to ^{90}Sr in plant tissues were also discussed. (auth)

Radiometric Techniques

Refer also to abstract 8830.

8674 (SZS-157, pp 230-231) APPLICATION OF NATURAL RADIONUCLIDES TO THE STUDY OF PROBLEMS OF HYDROLOGY AND ENVIRONMENTAL PROTECTION. Andreeff, A.; Froehlich, K.; Hebert, D.; Kater, R. (Bergakademie, Freiberg, Ger.). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The application of the measurement of natural radioisotopes found in water and air to the determination of flow times, entry region, duration and circumstances of pollution, T from weapons testing, and tritium release from nuclear power plants is discussed and a method is given which does not require a supplementary tracer. (tr-auth)

8675 ARE NEUTRONS GENERATED BY LIGHTNING? Fleischer, R.L. (Atmsopheric Physics and Chemistry Laboratory, NOAA, Boulder, Colorado 80302); Plumer, J.A.; Crouch, K.J. Geophys. Res. 79: No. 33, 4853-4858 (20 Nov 1974).

The suggestion of L. M. Libby and H. R. Lukens that lightning—generated neutrons may explain secular anomalies in carbon dating has been tested in a simple manner by placing passive, integrating, particle track dosimeters close to controlled man—made discharges that closely simulate the high—temperature phases of natural lightning strikes. The limits on neutron production that have been set in these experiments ($4 \cdot 10^8$ thermal neutrons per lightning flash and $7 \cdot 10^{10}$ 2.45—MeV neutrons) are several orders of magnitude lower than the levels needed to affect carbon dating or fission track dating over times that are geologically or archeologically significant. (auth)

8676 AGE DETEMINATIONS OF FOSSIL CORALS USING ^{230}Th/^{234}Th AND ^{230}Th/^{227}Th. Moore, W.S. (U.S. Naval Oceanographic Office, Washington, D.C. 20373); Somayajulu, B.L.K. J. Geophys. Res. 79: No. 33, 4905-4905 (20 Nov 1974).

The growth toward radioactive equilibrium of ^{230}Th with ^{238}U and of ^{231}Pa with ^{235}U has successfully been used to determine the ages of fossil corals. The chemical procedures employed in these measurements can be simplified dramatically if only thorium isotopes need be measured. Our method uses ^{234}Th as a measure of ^{238}U and uses ^{227}Th as a measure of ^{231}Pa to calculate the age of the coral. In addition to reducing the length of time required for an analysis by more than one half, our method does not rely on spikes but on a calibration standard that is counted to determine relative alpha and beta counting efficiencies. Ages of fossil corals from Jamaica correlate with the 120,000— to 135,000—yr—high sea stand reported by other workers. (auth)

8677 PROCEEDINGS OF THE EIGHTH INTERNATIONAL RADIOCARBON DATING CONFERENCE HELD AT LOWER HUTT, NEW ZEALAND, OCTOBER 18–25, 1972. Volume I. Rafter, T. A.; Grant-Taylor, T. (comps.). Wellington, New Zealand; Royal Society of New Zealand (1972). vp. (CONF-721019-(P1)). $8.00.

Two introductory speeches and 38 papers on radiocarbon dating presented at the conference are included in this volume. A separate abstract was prepared for both introductions and for each of 34 papers. Four papers were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 8626–8630, 8643, 8655–8657, 8667, and 8678–8703.

8678 RADIOCARBON DATING, MEMORIES, AND HOPES. Libby, W. F. (Univ. of California, Los Angeles). pp XXVII-XLIII of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

The history of radiocarbon dating from 1939 to the present is reviewed. The basic principles of radiocarbon dating are that cosmic rays make living things radioactive with ^{14}C to a certain level fixed by the environment and that at death the intake of food stops so no replenishment of the ^{14}C steadily lost by the immutable decay occurs. Therefore measurement of the degree of decay gives the time lapse since death, i.e., the radiocarbon age. The equipment developed and experiments performed to measure the specific activity of specimens to be dated are described. The results obtained by world-wide experimenters are discussed. These showed that on simultaneity radiocarbon dating is apparently reliable but that absolute dates may be incorrect by as much as 600 to 700 y. The value of radiocarbon dating to archaeologists, geologists, climatologists, and historians is stressed. (LCL)

8679 RADIOCARBON DATING AS A POINTER IN TIME TO THE ARRIVAL AND HISTORY OF MAN IN AUSTRALIA AND ISLANDS TO THE NORTH WEST. Macintosh, N. W. G. (Univ. of Sydney). pp XLIV-LVI of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

The identification of human fossil remains from different areas of the world and especially the radiocarbon dating of human and dingo skeletons found in Australia are discussed. (LCL)

8680 DISCUSSION OF RADIOCARBON DATES OBTAINED FROM PRECISELY DATED SEQUOIA AND BRISTLECONE PINE SAMPLES. Michael, H. N.; Ralph, E. K. (Univ. of Pennsylvania, Philadelphia). pp A11-A27 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

A set of correction factors for radiocarbon dates of archaelogical specimens is presented in tabular form. The method by which the correction factors were derived is presented. (auth)

8681 DENDROCHRONOLOGIC CALIBRATION OF THE ^{14}C TIME SCALE. Damon, P. E.; Long, A.; Wallick, E. I. (Univ. of Arizona, Tucson). pp A28-A43 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Sufficient data are now available to provide a reliable conversion table from radiocarbon years to tree ring years for the last 7355 y B. P. (before 1950 A. D.). Tree ring years are believed to be exactly equal to solar years. An accurate state-of-the-art conversion table is presented. The square root of the variance of the corrected dates is an inherent function of time. This results from a greater heliomagnetic modulation effect during periods of low geomagnetic field intensity as compared to periods of high geomagnetic field intensity. Thus, for example, considering individual dates, the radiocarbon time scale can be more precisely defined from 500 y through 2200 y B. P. (before 1950 A. D.) than from 4800 y to 6500 y B. P. (auth)

8682 SHORT-TERM TRENDS IN NATURAL RADIOCARBON. Farmer, J. G.; Baxter, M. S. (Univ. of Glasgow). pp A58-A71 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Radiocarbon assay of single tree rings for the period 1829-65 indicates a significant correlation of atmospheric ^{14}C levels in the northern hemisphere with sunspot number over the 11-year solar cycle. Such a correlation is not apparent in the southern hemisphere, at least as deduced from 20th Century ^{14}C data. It is suggested that the solar-terrestrial relationship, involving solar-sensitive variations of ^{14}C production and atmospheric exchange, may itself vary with latitude and time. Fluctuations of 3% in ^{14}C levels over 10 years imply an increased dating error of ±120 years for short-lived samples. In addition the study reinforces the need for standardisation both of ^{14}C reference material and of pretreatment procedures. The implications of stable isotope analyses of annual tree rings which grew between 1895 and the present are discussed with regard to the build-up of the industrial Suess effect. (auth)

8683 VULCANISM AND RADIOCARBON DATES. Libby, L. M.; Libby, W. F. (Univ. of California, Los Angeles). pp A72-A75 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

The question of whether the long term perturbation of radiocarbon dates, which is known to be approximately a sin function of period about 8000 y and amplitude of about 8% peak-to-peak, could have been caused in any major part by vulcanism is considered. It is concluded that this is not the case. On the contrary, present day volcanoes are a far less important source of inert CO_2 (about 100 fold less) than is man's burning of fossil fuels which has caused the Suess dilution of about 2%. (auth)

8684 TREE-RING CALIBRATION OF RADIOCARBON DATES. Berger, R. (Univ. of California, Los Angeles). pp A97-A103 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

During the last three years an experiment was conducted in the White Mountains of California to check the diffusion of tree-sap across tree-rings in mature bristle-cone pines with the aid of elevated levels of radiocarbon. No transfer of radioactivity across a significant number of tree-rings could be detected. Another set of experiments involving radiocarbon from nuclear weapons testing and its incorporation in mature bristle-cone pine and oak trees also revealed no transport across tree-rings. Certain construction techniques used in the Middle Ages as well as today support the view that transport across the grain of timber is negligible. All these observations confirm the isotopic integrity of carbon molecules in high-polymer wood substances laid down after photosynthesis in tree-rings. Consequently individual tree-rings can be used to assess the climatic, geomagnetic and radiation environment of any respective year. (auth)

8685 GEOMAGNETIC FIELD BEHAVIOR BETWEEN 25,000 AND 35,000 YEAR B. P. AND ITS EFFECT ON ATMOSPHERIC RADIOCARBON CONCENTRATION: A CURRENT REPORT. Barbetti, M. (Australian National Univ., Canberra). pp A104-A113 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Some preliminary data on the variation in geomagnetic field intensity during the period from 25,000 to 35,000 y B. P. are presented. These data suggest there may have been much larger variations in the atmospheric radiocarbon concentrations during this period. (LCL)

8686 BOMB COMBUSTION OF RADIOCARBON SAMPLES. Burleigh, R. (British Museum, London). pp B1-B10 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Oxidation of the sample material to carbon dioxide is the starting point for all methods of ^{14}C measurement currently in use for radiocarbon dating. Conventionally, some form of large-scale tube furnace is used for combusting samples but this is generally a time consuming procedure requiring constant supervision. An alternative method by which the samples can be combusted much more rapidly and efficiently in a specially designed bomb is described. After the bomb method had been successfully used several hundred times over a period of about four years at the British Museum laboratory, a serious explosion occurred during a routine combustion which destroyed the original bomb. This explosion was probably caused by fine sample material suspended in the bomb atmosphere. However, because of its superiority in our opinion, use of the method was not discontinued after the accident but a new inherently safer version of the bomb, fitted with a bursting disc, was designed and manufactured commercially. Pelleted samples are now used to eliminate dust and to reduce the rate of combustion, and for complete safety the bomb is fired remotely. (auth)

8687 COMBUSTION BOMBS FOR RADIOCARBON DATING. Switsur, V. R. (Cambridge Univ., Eng.). pp B11-B23 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Combustion of samples for radiocarbon dating in an atmosphere of pure oxygen at elevated pressure in a "bomb" offers several advantages over conventional oxidation with a stream of oxygen in a heated quartz tube. The conditions are not critical; constant attention by a technician is unnecessary; the time required for combustion is only a few minutes; the issuing combustion gases are much cleaner and need less purification for further syntheses of methane, acetylene or benzene. The development of suitable combustion units for the oxidation of samples sufficiently large for radiocarbon dating is traced, from preliminary experiments with a Berthelot bomb, through investigations with early vertical types, to the latest horizontally orientated bomb with its much improved specimen access, user facilities, and safety features. This method may be used for all normal types of samples including cloth, reeds, seeds, charcoal, wood, peat and other plant remains, and collagen. New developments are mentioned which bring "difficult" samples, such as lake-mud and soils of very low carbon content, within the scope of the method. (auth)

8688 RADIOCARBON DATING BY CARBON DIOXIDE METHOD: INFLUENCE AND REMOVAL OF KNOWN IMPURITIES. Freundlich, J. C.; Rutloh, M. (Univ., Cologne). pp B24-B35 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

In an investigation on the effects of electronegative impurities upon the performance of CO_2-filled proportional counters, gas samples of high purity carbon dioxide were doped by precisely known trace amounts of impurities. The influence of these impurities on the performance of the proportional counters and on age determination are studied and compared with other work in this field. The efficiency of the purification system is verified by the results of re-purifying some of the quantitatively-doped gas samples. (auth)

8689 SYNTHESIS OF HIGH PURITY BENZENE FOR RADIOCARBON DATING. Polach, H. A.; Gower, J.; Fraser, I. (Australian National Univ., Canberra). pp B36-B49 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Benzene is prepared by allowing purified acetylene to slowly sublime onto a catalytic column containing 260 g of Noakes' cracking catalyst. By heating the catalyst to 110 ± 2°C benzene can be recovered in a liquid N_2 cooled trap. (LK)

8690 IMPROVEMENT IN TRIMERIZATION OF ACETYLENE TO BENZENE FOR RADIOCARBON DATING WITH A COMMERCIALLY AVAILABLE VANADIUM OXIDE CATALYST. Coleman, D. D.; Liu, C. L.; Dickerson, D. R.; Frost, R. R. (Illinois State Geological Survey, Urbana). pp B50-B62 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

A new technique for preparing the catalyst greatly simplifies the synthesis of large benzene samples for liquid scintillation radiocarbon dating. For reliable age determinations on samples more than 40,000 years old, our present facilities require synthesis of 16 ml of benzene. Synthesis of this amount of benzene with a commercially available vanadium oxide catalyst activated as described by Noakes, Kim, and Stipp (1965) required 300 g of catalyst and resulted in average acetylene to benzene yields of 70 to 80%. If the catalyst is oxidized in air at 550°C for 2 hours, 16 ml of benzene can be synthesized with 50 g of catalyst, with average yields of 92 to 96%. Catalyst prepared in this way may also be used to synthesize smaller benzene samples. Twenty grams of catalyst can be used to synthesize from 1 to 8 ml of benzene with equally high yields and with no detectable impurities. Exposure of the oxidized catalyst to the atmosphere greatly decreases the rate at which it will trimerize acetylene but has no apparent effect upon the percentage yield of benzene. The yield is also, under normal conditions, independent of the acetylene pressure and the amount of catalyst present. The principal factor limiting the yield is interpreted as being a side reaction of acetylene with vanadium oxide in the catalyst. An oxygenated by-product is formed, which remains on the catalyst when the benzene is vacuum extracted. The presence of V_2O_4 in the catalyst appears to enhance this reaction and decrease the percentage yield of benzene. A by-product has been recovered from spent catalyst by solvent extraction. Carbon-hydrogen analysis of the extract shows that it has an average empirical formula of $C_{13}H_{11}O$. Infrared analysis indicates the extract is a mixture of highly aromatic polymers containing carbonyl and hydroxyl groups. (auth)

8691 TRANSFER OF CARBON FROM SOLVENTS TO SAMPLES. Jansen, H. S. (Inst. of Nuclear Sciences, Lower Hutt, New Zealand). pp B63-B68 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Carbon-14 labelled solvents were used to extract Dacrydium cupressinum Lamb., Agathis australis and Sequoia gigantea to study transfer of carbon from solvent to wood. Solvents were ethanol, ethylacetate, benzene, methanol, acetone and mixtures of methanol/benzene and ethanol/benzene. Extracted wood was dried at normal or reduced pressure, at temperatures of 90 or 120°C, for different lengths of time in a heated vacuum dessicator, a general purpose laboratory drying oven and an oven with temperature control within 0.1°C. It was found that carbon transfer of up to several percent could occur with a general purpose oven, but less than 0.5% with the controlled oven, except when methanol was used for extraction. It was also noted that samples that had dried for some days would take up solvent carbon when fresh samples were put into the same oven. Vacuum speeded up the removal of solvent carbon but it did not affect the ultimate retention. Poor drying techniques have led to addition of up to 27% of solvent carbon in a counter sample. (auth)

8692 COMPARISON: PROPORTIONAL COUNTER AND LIQUID SCINTILLATION SPECTROMETER FOR RADIOCARBON DATING. Geyh, M. A. (Niedersaechsisches Landesamt fuer Bodenforschung, Hanover). pp B81-B93 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Nowadays, two radiometric techniques are given preference in radiocarbon dating: measurements with proportional counters and with liquid scintillation spectrometers. Both techniques are compared in theoretical and practical respects. Proportional counters are superior if one considers sensitivity, maximum age and samples of small carbon content. The liquid scintillation spectrometer is somewhat inferior compared with proportional counters because of its less detection efficiency, its higher background and its greater system error. The latter restricts the permitted counting time, and independent of the sample size, the dating range. For routine dating of samples containing the same weight of carbon, however, both techniques are comparable in initial price and maintenance costs, as well as in time required for sample preparation. But, because there is no radon or memory problems with consequential sample storage and counter filling time, the liquid scintillation spectrometer seems to have advantages. However, the specifications of both techniques are so different that neither can be given a general recommendation. The working conditions of the ^{14}C laboratory should determine the specific choice of the most suitable detector system. (auth)

8693 MOBILE ARCHEOLOGICAL LABORATORY: MICROSAMPLE EXTRACTION AND RADIOCARBON DATING. Noakes, J. E.; Schneider, K. A.; Brandau, B. L. (Univ. of Georgia, Athens). pp B94-B100 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

The importance of plant and animal remains in inferring past ecological conditions and cultural practices is increasingly recognized. Equally important, these remains can provide archeologists with a temporal framework leading to chronological interpretation through radiocarbon dating. A mobile archeological laboratory has been developed at the University of Georgia. The mobile laboratory is self-propelled and capable of traversing rough terrain to reach archeological sites. Mobile laboratory equipment includes microsample extraction components designed to retrieve small botanic and faunal remains for identification and age determinations, and radiocarbon dating instrumentation and support systems for assisting on-site excavation. Field operation of the mobile laboratory on interior and coastal Georgia (U. S. A.) archeological sites will be discussed. (auth)

8694 SOME APPLICATIONS IN RADIOCARBON MEASUREMENT AT THE SCOTTISH RESEARCH REACTOR CENTRE. Harkness, D. D.; Wilson, H. W. (Scottish Research Reactor Centre, East Kilbride). pp B101-B115 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

The establishment of a radiocarbon laboratory primarily for earth science investigations and some of its current applications are described. A simplified and versatile ^{14}C dating technique has been developed based on established liquid scintillation methods. Procedures described for the synthesis of benzene include: (i) carbon dioxide production via a semi-automatic high pressure combustion system, (ii) rapid and efficient production of acetylene (97 ± 2% yield) requiring only 1.8 gm lithium/litre atmosphere carbon dioxide, and (iii) trimerisation of acetylene to high purity benzene (96 ± 1% yield) using a commercially available chromium catalyst. Aspects of counting discussed involve: (i) optimisation of the liquid scintillation counter for low level ^{14}C measurement, (ii) the suitability of standard glass counting vials in routine dating, and (iii) counter operation and stability. (auth)

8695 EFFECTS OF SOLUTION AND EXCHANGE ON THE RADIOCARBON DATING OF SEDIMENTS AND NATURAL WATERS. Buddemeier, R. W.; Okamoto, H. S.; Hurd, D. C.; Hufen, T. H. (Univ. of Hawaii, Honolulu). pp C73-C86 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Tracer studies have been used to characterize the equilibrium exchange between solid and dissolved calcite in saline solutions. The exchange is found to occur by successive stages, each obeying reversible first order kinetics. These are identified as progressive recrystallization of molecular layers below the solid surface; the difference between successive rate constants is approximately one order of magnitude. ^{45}Ca uptake was also used to measure surface areas, and to investigate chemical and temperature effects on exchange rates. Since the recrystallization proceeds through a dissolved intermediate, the observations are relevant to solution as well as equilibrium situations. Exchange of $H^{14}CO_3^-$ with calcite in artificial seawater has a half-time of 85 min for the first surface layer. Extrapolation of these results to natural systems suggests that recrystallization exchange may significantly alter the apparent radiocarbon ages of marine carbonates with large specific surface areas, and of water with which such carbonates exchange. It is suggested that ^{45}Ca uptake studies may be a means of estimating the exchange history of carbonate sediments. Groundwater studies on the island of Oahu indicate that stable isotope corrections for carbonate solution and exchange yield excellent results if the initial characteristics of the recharge water are known. Radiocarbon activities of saline groundwater in a limestone coastal environment represent a complex situation which cannot be treated by conventional methods for either fresh water or ocean water dating. (auth)

8696 ^{14}C ACTIVITY AS AN INDICATOR OF COURSE OF DISSOLVED ORGANIC CARBON IN RIVERS AND LAKES. Rubin, M.; Spiker, E. (Geological Survey, Washington, DC). pp D13-D18 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

To distinguish between the organic chemical pollution due to industrial wastes and that of domestic effluents, the ^{14}C activity of the dissolved organic carbon in natural surface waters was measured. High intensity ultraviolet radiation was used to photooxidize the carbon in large water samples. After sparging with oxygen in a tall scrubbing column, the CO_2 collected was analyzed for ^{14}C in the conventional manner. Streams bordered by relatively little industry show the present ^{14}C activity of the atmosphere, indicating carbon contribution from sewage treatment plants and farmers' feed lots. Streams flowing past concentrations of industry show varying amounts of depression of the ^{14}C activity, reflecting the contribution of ^{14}C deficient fossil fuels. (auth)

8697 ^{14}C AGES OF WATER FROM THE ARKANSAS HOT SPRINGS. Pearson, F. J. Jr.; Bedinger, M. S.; Jones, B. F. (Geological Survey, Washington, DC). pp D19-D30 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

The Arkansas Hot Springs are on the southern margin of the Ozark Mountains, Arkansas, and have surface temperatures from 55 to 62°C. Recharge to them is through the Bigfork Chert, which is principally chalcedony but also contains carbonate beds and lenses. The flow paths to the springs pass through the Arkansas Novaculite and they emerge from the Hot Springs Sandstone, both carbonate-free formations. The silica content of all the Hot Spring waters is 41-42 mg/l, which is equivalent to chalcedony saturation at 63°C. The Hot Springs themselves and cold spring and well waters from the Bigfork Chert are calcium bicarbonate waters. The Hot Springs contain less calcium and bicarbonate but could be derived from cold Bigfork waters by precipitation of $CaCO_3$ accompanying heating. $\delta^{13}C$ values of carbonate species dissolved in all waters range from -13 to -15‰, with those of the Hot Springs corresponding to Bigfork water to the northeast of the Springs. No carbonate isotope exchange has occurred because of lack of carbonate minerals in the area of heating and/or relatively rapid flow through and low surface area of water-bearing fractures in the area of heating. The adjusted ^{14}C age of the Hot Springs waters is 4600 y, while ages of up to 9000 y are found in cold spring waters in the Bigfork Chert. Variations in permeability along the length of flow paths may explain these age differences. (auth)

8698 RECONSTRUCTION OF THE INITIAL ^{14}C CONTENT OF GROUNDWATER FROM THE CHEMICAL AND ISOTOPIC COMPOSITION. Mook, W. G. (Univ. of Groningen, Netherlands). pp D31-D41 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

In order to be able to determine with ^{14}C the absolute age of groundwater, i.e., the elapse of time between infiltration and sampling, the initial specific ^{14}C activity of the inorganic carbon content should be known. It is shown that, if the reaction $CaCO_3 + CO_2 + H_2O \rightarrow Ca^{2+} + 2HCO_3^-$ is responsible for the dissolved carbon, and if some further conditions are fulfilled, there is a unique relation between the initial ^{14}C content, the concentrations of dissolved carbon dioxide and bicarbonate, and the stable carbon isotopic composition: $A_\Sigma = (1/a + b)\{aA_{ao} + bA_{bo} + (A_{be} - A_{bo})[(a + b)\delta_\Sigma - a\delta_{ao} - b\delta_{bo}/\delta_{be} - \delta_{bo}]\}$. This relation obeys different models for the dissolution-exchange process in the soil. (auth)

8699 ISOTOPE RATIOS PRESERVED IN PEDOGENIC CARBONATE AND THEIR APPLICATION IN PALAEOPEDOLOGY. Leamy, M. L.; Rafter, T. A. (Inst. of Nuclear Sciences, Lower Hutt, New Zealand). pp D42-D57 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Pedogenic carbonate is defined as calcium carbonate generated by soil processes and deposited in the subsoil. It is suggested that it may be a source of palaeoclimatic data comparable to the calcium carbonate of planktonic Foraminifera preserved in deep-sea sediments, and to the calcite of speleothems. Brown-grey earths of the semi-arid regions of Central Otago, New Zealand, are characterised by accumulations of pedogenic carbonate below an illuvial clay B horizon. The calcareous horizons from two profiles were sampled at intervals of from 4 to 6 cm and the samples were dated by ^{14}C age determination. The older profile records events occurring back to approximately 40,000 y ago, while the younger profile has been forming over about the last 7,500 y. In both profiles there are examples of stratigraphically inferior horizons yielding radiocarbon ages younger than those obtained from the carbonate in overlying horizons. It is suggested that such radiocarbon date reversals represent a change in climatic conditions which resulted in the leaching of pedogenic carbonate to a greater depth during that period. In the two profiles studied such reversals indicate a cessation of carbonate accumulation 6550 y ago, which coincides approximately with the post-glacial thermal maximum; 23,300 y ago, which marks the onset of an advance of the Otira Glaciation; and possibly at 31,900 y ago, which may represent the termination of an interstadial period of the Otira Glaciation. (auth)

8700 DETERMINATION OF THE INITIAL ^{14}C CONTENT IN GROUNDWATER. Geyh, M. A. (Niedersaechsisches Landesamt fuer Bodenforschung, Hanover). pp D58-D69 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

A critical consideration of the applied methods to determine the initial ^{14}C content in groundwater for its "absolute" age determination shows that as a consequence of oversimplification none promises reliable results. Instead, an empirical method to estimate the initial ^{14}C content applying the exponential model is recommended. Both ^{14}C and ^{3}H analyses have to be performed on a minimum of two groundwaters of the same catchment area and for two seasons in order to obtain reliable results. Besides the initial ^{14}C content in young groundwaters, their mean residence times and seasons of recharge are determinable. Single ^{14}C and ^{3}H measurements, however, are not sufficient for such determinations as well as for estimations of admixing rates, etc. Generalizing, it has been found that the initial ^{14}C content in groundwater depends essentially upon the geology of the catchment area. The ranges of 65-75, 75-90 and 90-100% modern belong to proto- and semi-karst, regions covered with limy sediments or crystalline rocks, respectively. These results are plausible and have been confirmed in some 100 examples. Thus far, the exponential model accounts adequately for the natural isotopic composition of young groundwater from different old components. The agreement of the classifications of a lot of springwaters and wellwaters based on both long-term hydrogeological observations and figures obtained by this method gives reason for its wide range applicability in practice. (auth)

8701 ^{14}C AND OTHER ISOTOPE STUDIES ON NATURAL ICE. Oeschger, H. (Univ., Bern); Stauffer, B.; Bucher, P.; Frommer, H.; Moll, M.; Langway, C. C.; Hansen, B. L.; Clausen, H. pp D70-D92 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

On the occasion of several field projects in Greenland, Antarctica and the Swiss Alps the extraction technique of traces from several tons of ice has been developed and perfected. The procedures are as follows. Surface ice samples are melted in vacuum melt vessels, whereas in bore holes the ice is melted "in situ" under vacuum at the desired depth. Until now the maximum depth from which samples have been extracted is 780 m. The gases escaping during the melting process are pumped through molecular sieve for drying and collection of CO$_2$. The remaining gases are compressed for further treatment in the laboratory. Soluble chemistry may be carried out either on the melt water pumped to the surface (collection of Si) or down hole by circulating the melt water through ion exchange resins (collection of CO$_2$). The melt water can be filtered for the collection of pollen, terrestrial and cosmic dust. At present uncontaminated CO$_2$, Ar and Si samples can be obtained for ^{14}C-, ^{32}Si- and ^{39}Ar-dating. The results of the ^{32}Si-samples allow to establish an apparent half life for ^{32}Si-ice dating. How the problem of causes for the ^{14}C-variations may be attacked by the study of isotopes with different geochemical behaviour is discussed. (auth)

8702 SOIL-CO$_2$ AND GROUNDWATER: CARBON ISOTOPE COMPOSITIONS. Lerman, J. C. (CNRS, Gif-sur-Yvette, France). pp D93-D105 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

Analyses of soil-CO$_2$ obtained with a specially developed sampling probe are described. Preliminary results show that the isotope composition of the soil-CO$_2$ matches the composition of the corresponding vegetation cover: e.g., for a succulent vegetation a distribution of δC 13 of soil-CO$_2$ with a mode at about −16‰ was observed. Results indicate also a higher contribution of CO$_2$ from root respiration than from humus decay. The importance of assessing δC 13 values of soil-CO$_2$ for absolute groundwater ^{14}C dating is discussed. (auth)

8703 FORMATION OF CARBONATE NODULES IN THE SOILS OF THE DARLING DOWNS, QUEENSLAND, AUSTRALIA, AND THE DATING OF THE TALGAI CRANIUM. Hendy, C. H. (Inst. of Nuclear Sciences, Lower Hutt, New Zealand); Rafter, T. A.; MacIntosh, N. W. G. pp D106-D126 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 1. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P1).

A study of the carbon isotopic composition of soil organic matter, carbonate nodules, present day ground waters and plants has shown that: the soil organic carbon formed since 10,000 y B. P. had identical ^{13}C/^{12}C ratios (−17‰) as plants of the subtropical grasslands ecosystem which are still found on uncultivated portions of the flood plains; soil organic matter formed prior to 10,000 y B. P. has a lower ^{13}C/^{12}C ratio and indicates a change in the plant cover from either temperate grasses or a forest ecosystem to subtropical grasses; the carbonate nodules found in the soil are in ^{13}C equilibrium with CO$_2$ produced from carbon of contemporary plant composition; the ^{14}C/^{12}C ratio of both the soil organic carbon and the carbonate nodules decreases with depth in the soil, the soil organic matter extrapolating to zero age at the surface, and the carbonate nodules extrapolating to zero age at about 80−100 cm depth in the soil. No nodules are found higher than 1 m depth. This suggests that the carbonate nodules form at about 1 m depth in equilibrium with soil CO$_2$; and the soil horizon at which the Talgai Cranium was found corresponds to the surface at 14,000 y B. P. (auth)

8704 PROCEEDINGS OF THE EIGHTH INTERNATIONAL RADIOCARBON DATING CONFERENCE HELD AT LOWER HUTT, NEW ZEALAND, OCTOBER 18−25, 1972. Volume II. Rafter, T. A.; Grant-Taylor, T. (comps.). Wellington, New Zealand; Royal Society of New Zealand (1972). vp. (CONF-721019-(P2)). $8.00.

Twenty-two papers on radiocarbon dating were presented at the meeting. A separate abstract was prepared for each of 18 papers. Four papers were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 8649, 8650, 8666, and 8705−8719.

8705 FACTORS AFFECTING RADIOCARBON ENRICHMENT IN SOIL AND THE TURNOVER OF SOIL ORGANIC MATTER. Stout, J. D. (Soil Bureau, Lower Hutt, New Zealand); O'Brien, B. J. pp E13-E26 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

The increase in atmospheric radiocarbon following thermonuclear testing has made possible enrichment studies of soil organic matter. These can be concerned with the factors affecting enrichment in different soils or with the rate of turnover of soil organic matter. Factors affecting soil enrichment are the kind of vegetation, the activity of soil animals, the climate (which affects the rate of decomposition), the permeability of the soil and total mass of carbon in the soil. The pattern of ^{14}C enrichment in different horizons of a soil over a period of time indicates the method of fixation of organic matter into the soil profile and the rate of turnover of the enriched material. In pastures the evidence suggests a relatively short turnover time for plant material. (auth)

8706 EXTRACTION AND USE OF PLANT LIPIDS AS A MATERIAL FOR RADIOCARBON DATING. Grant-Taylor, T. L. (Geological Survey, Lower Hutt, New Zealand). pp E58-E66 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

The problem of solution borne contamination of carbonaceous materials is one of the most important faced in obtaining radiocarbon ages. Many laboratories have conventionally used an alkali and acid pretreatment in the hope that this would remove any contamination. These treatments cannot be regarded as very satisfactory because of the lack of knowledge of the chemical nature of the contaminating material, ignorance of the kind of alterations which may affect this material in nature, and ignorance of the effects of the reagents used in the laboratory which after all must be quite different from the generally weak acid natural environment. A brief analysis of a range of plant materials suggests that there could be three differing groups of substances which might be present in peats and soils and not significantly contaminated by material carried in solution. These are cellulose, resin, and wax (lipids). Cellulose and resin were discarded for several reasons. Lipids have been extracted by simple extraction in a soxhlet, and the results to date suggest that these are often obtainable in quantity that makes them usable as dating material. They could be used for routine dating of more carbonaceous soils as well as peats and would provide a reference standard for the examination of soils by radiocarbon dating. (auth)

8707 EXTENDING THE USE OF BOMB CARBON IN THE LIFE SCIENCES. Jansen, H. S. (Inst. of Nuclear Sciences, Lower Hutt, New Zealand). pp F1-F26 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

Families of curves have been prepared to predict Δ^{14}C values due to bomb ^{14}C in tissue or tissue components for eight bands of latitudes and fourteen retention times of carbon. Calculations were based on published data for atmospheric carbon dioxide and rapidly growing plant material. It is shown how use of these graphs enables bomb ^{14}C to be used for planning experiments and interpreting results in studies of rates of replacement of carbon in tissues and equivalent problems. Errors from feeding habits, birth carbon and travel, are evaluated. (auth)

8708 DETERMINATION OF AGE AND DURATION OF STRATIFIED PREHISTORIC BOG SETTLEMENTS. Mook, W. G. (Univ. of Groningen, Netherlands); Munaut, A. V.; Waterbolk, H. T. pp F27-F40 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

The floating tree-ring chronology for the Swiss Neolithic site of Thayngen–Weier and Burgäschisee–Süd has now been extended to include also the site of Niederwil. Radiocarbon measurements of dendrochronologically dated grain samples from Niederwil attest an increase in natural radiocarbon activity of nearly 2.5% within a period of 15 ± 6 years at about 3680 BC. The combined dendrochronological and radiocarbon evidence from the three sites shows that there may be a time difference of 50 to 120 years between the death of the wood and its first use as building material. This is probably caused by the surplus of valuable high-age timber that became available when the natural forest was cleared for making arable land. (auth)

8709 UTILITY OF RADIO-CARBON DETERMINATIONS FOR DATING N.Z. ARCHAEOLOGICAL SITES. Coutts, P. J. F. (Univ. of Otago, New Zealand). pp F52-F68 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

Some of the requirements of a suitable absolute dating scheme for New Zealand prehistory are outlined, and using these as a basis for comparison, some of the shortcomings of current ^{14}C sequences are identified. They are illustrated by referring to the results of an analysis of a series of ^{14}C dates from two laboratories for several archaeological sites in Fiordland, southern New Zealand. (auth)

8710 NATURAL RADON AS A SOURCE OF LOW LEVEL LABORATORY CONTAMINATION. Freundlich, J. C. (Univ., Cologne). pp G1-G10 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

In a provisional assembly of a dating apparatus in a provisional basement room with poorly finished walls, a strong day/night effect of background count rate appeared. Radioactivity variations of equal time-dependence could be observed by a simple cosmic-ray counting tube in the same room. Several samples of aerosols were taken there, and their radioactivity proved to be due to the radium decay series, from their gamma-spectrum and decay times. This day/night effect, together with a similar amount of activity rise during free days (i.e., public holidays, weekends etc.) evidently was due to (a) small radon traces continually diffusing in from subsoil through small mortar gaps of the brickwork walls and (b) room air convection differing between working hours, and night hours (also holidays), respectively. On the subsequent final position in the well-finished underground laboratory the same apparatus still showed marked variations of the background count rate though at less regular intervals. These variations could be eliminated (down to the proper Poisson statistics value) by: carefully sealing all the visible openings, fissures, and cracks in the finish all along the wall faces and edges, and the ceiling of that room (the floor being all right); switching the air conditioning system upon "fresh air supply" rather than "stale air exhaust" mode, i.e., maintaining slightly raised pressure of laboratory air over the surroundings; and sealing of counters in a plastic sheet envelope. In the sequel, fluctuations of the count rate beyond the permissible Poisson range have been observed. The net background count rates of all counters in that room, moreover, have been appreciably lowered. (auth)

8711 CRITICAL ANALYSIS OF ^{14}C DATINGS OF DEPOSITS CONTAINING LITTLE CARBON. Olsson, I. U. (Inst. of Physics, Uppsala). pp G11-G28 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

It is demonstrated that deposits containing little organic material are often contaminated with allochthonous material, which may cause the ^{14}C dates to be much too high if the fraction insoluble in hot NaOH is used. The soluble fraction often yields more reliable ages. The contaminations may have "infinitely high ages" and are suspected to be graphite from their behavior on combustion and their δ^{13}C values. (auth)

8712 RELIABILITY OF RADIOCARBON DATES FROM BURIED CHARCOALS. Goh, K. M. (Lincoln Coll., Canterbury, Australia); Molloy, B. P. J. pp G29-G45 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

The reliability of radiocarbon dates obtained from soil buried charcoals was examined by radiocarbon assay of charcoal samples following particle size separation and also before and after various chemical pretreatments. These studies were further substantiated by humus fractionation and elemental chemical analyses. Radiocarbon results indicated that larger particles of charcoal yielded a significantly older age than finer particles. This was strongly correlated with the content of easily extractable fulvic acid. Acidified humin fractions obtained as residues after repeated extractions with an alkali mixture (0.1 M $Na_4P_2O_7$: 0.1 N NaOH) gave significantly older ages than either the untreated charcoals or their humic acids. Residues resulting from chemical treatments commonly used to extract soil lipids and to hydrolyze soil proteins and soil carbohydrates did not produce an increase in the radiocarbon ages as compared with those of the untreated charcoals. These results strongly suggest that repeated pretreatment with an alkali mixture provides an efficient means of removing soil humic contaminants from buried charcoals and thereby leads to an improvement in the reliability of their radiocarbon dates. (auth)

8713 EFFECT OF ALKALINE PRETREATMENT ON THE RADIOCARBON DATES OF SEVERAL NEW ZEALAND CHARCOALS. Bailey, J. M.; Lee, R. (Soil Bureau, Lower Hutt, New Zealand). pp G46-G55 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

Various charcoals from a volcanic area of the central North Island of New Zealand were extracted with 0.5M NaOH and the resulting fractions (original, residue and extract) sent for radiocarbon dating. Of the seven charcoals so far dated, four yielded extracts with younger dates than their parent charcoals (although for two of the four the difference is marginal). Contrary to expectation the removal of this younger material did not lead to a corresponding increase in the age of the residue. Possibly some older material was removed by the extraction process, which was not subsequently retained in the extract fraction, and which consequently had the reverse effect on the date of the residue than the removal of younger material. Because of the uncertainties involved in the extraction process it is proposed that where humic acid is found three fractions should be dated—original, residue and extract. When all three dates are identical the humic acid cannot be said to be age affecting, and the average date is the most acceptable for the event in question. (auth)

8714 CONDITIONS FOR THE USE OF CALCIUM CARBONATE AS A DATING MATERIAL. Grant-Taylor, T. L. (Geological Survey, Lower Hutt, New Zealand). pp G56-G59 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

Calcium carbonate has been very widely viewed with extreme suspicion as a dating material, because of the frequent exchange of carbonate with the environment. Many organisms with calcium carbonate exoskeletons deposit it in the aragonite crystal form. Outside the biological medium aragonite is metastable at surface pressures (except in a magnesium rich environment). Any interference with the aragonite crystal results in an inversion to the stable crystal form, calcite. For approximately 10 years New Zealand experimenters have been examining all shells under diffraction x-ray or infrared spectroscopy, both of which detect calcite at less than 1%. By using only aragonite depositing species and testing all for recrystallization it is assumed that the carbonate still has its original isotopic composition, affected only by the passage of time. The provision of an appropriate secondary standard is the only additional requirement for an accurate date. (auth)

8715 EVALUATION OF RADIOCARBON MEASUREMENTS AND INHERENT STATISTICAL LIMITATIONS IN AGE RESOLUTION. Currie, L. A. (National Bureau of Standards, Washington, DC). pp H1–H15 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019(P2).

A uniform approach, based upon the statistical behavior of random measurement errors, is suggested for assessing the relative merit of alternative methods of measuring radiocarbon and for interpreting and reporting the results of such measurements. The need for an objective, uniform approach is manifest because of the increasing concern with results which are close to the limits of precision or detection of the dating procedures. The standard deviation of the estimated net signal (sample counts) is first examined in terms of its dependence upon random errors arising in observations of background and gross sample counts. Because of the high precision characterizing such observations, it becomes vital to evaluate random errors additional to the Poisson (counting) errors. The ability to discriminate between samples of similar age, and minimum and maximum detectable ages are discussed in terms of the statistical theory of hypothesis testing. An explicit approach results for the uniform treatment of detection, detectability and age limits. The performance characteristics of alternative measurement methods cannot simply be stated in terms of a single "figure of merit," because of the rather complex dependence upon counting times, sample, background and modern standard counting rates, and non-Poisson sources of random errors. A "reduced activity" (sample activity/background equivalent activity) plot is offered as a means for planning experiments and for rapidly assessing the capabilities of any specific measurement procedure. As a result of the particular choice of variables for this plot, alternative procedures may be represented by points in a fixed, two-dimensional array, where simple translations of the entire array correspond to changes in counting time or sample age. (auth)

8716 CARBON 14 DATING: ORIGIN AND CORRECTION OF ISOTOPE FRACTIONATION ERRORS IN TERRESTRIAL LIVING MATTER. Lerman, J. C. (CNRS, Gif-sur-Yvette, France). pp H16–H28 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

The contribution of carbon isotope fractionation by land plants to ^{14}C dating errors is assessed, and its correlation with different photosynthetic pathways discussed. Errors in radiocarbon analyses on plant and animal materials, when not corrected by use of the ^{13}C/^{12}C ratio, may give apparent ages from 200 y older to 300 y younger. Suggestions and examples concerning correction of radiocarbon dates are given, allowing higher accuracy in many cases when the ^{13}C/^{12}C measurements have not been done. (auth)

8717 NEW ZEALAND RADIOCARBON REFERENCE STANDARDS. Rafter, T. A. (Inst. of Nuclear Sciences, Lower Hutt, New Zealand); Jansen, H. S.; Lockerbie, L.; Trotter, M. M. pp H29–H79 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

Since ^{14}C/^{12}C variations predicted from ^{13}C/^{12}C ratios were shown to exist in nature, the necessity to make corrections for such isotope effects to give correct "^{14}C ages" especially for archaeological specimens was realized. Even after this correction is made, because of the nature of the environment of the specimen, a correction relating to this environment may also be necessary. Studies made also indicate that in biological processes isotopic equilibrium may not be achieved. Such studies bring out the necessity for contemporary standards relating to the particular specimen to be dated. At this laboratory contemporary reference standards for marine shells and freshwater shells, Antarctic specimens, terrestrial bone specimens and land snails were developed. Standards for soils are still being investigated. These standards are discussed, as is the pretreatment given to samples before processing. (auth)

8718 DENDROCHRONOLOGICALLY-DERIVED PRIMARY STANDARD FOR RADIOCARBON DATING. Bannister, B.; Damon, P. E. (Univ. of Arizona, Tucson). pp H80–H89 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

The customary usage of oxalic acid (age corrected to A.D. 1890 wood) as a standard reference sample in most radiocarbon laboratories has been questioned by some workers as a result of observed isotopic fractionation of derived counting gas. H. A. Polach and others have proposed that alternative materials be evaluated as a possible substitute for oxalic acid and, since the original A.D. 1890 wood standard is not available, that a new primary wood standard be developed. They suggest that the existence of a carefully chosen and reliably dated primary wood standard, along with a large amount of readily available secondary standard not subject to the difficulties encountered with oxalic acid, would be of significant benefit to radiocarbon dating laboratories. The Laboratory of Tree-Ring Research at the University of Arizona was requested to prepare a precisely dated primary wood standard in sufficient quantity that at least 20 radiocarbon laboratories could perform the required calibration with the new secondary standard. To avoid industrial-age contamination, and in consideration of pertinent radiocarbon and sunspot data, it was recommended that the wood cover the years A.D. 1846–1855 inclusive. Twenty-two dendrochronologically-derived primary wood standard packets, averaging 40 grams each following pretreatment, are available for distribution to selected radiocarbon dating laboratories. (auth)

8719 CORRELATION OF ^{14}C ACTIVITY OF NBS OXALIC WITH ARIZONA 1850 WOOD AND ANU-SUCROSE RADIOCARBON DATING STANDARDS: A PRELIMINARY REPORT OF INVESTIGATIONS AND RESULTS. Polach, H. A. (Australian National Univ., Canberra); Krueger, H. A.; Bannister, B.; Damon, P. E.; Rafter, A. T. pp H90–H120 of Proceedings of the Eighth International Radiocarbon Dating Conference. Vol. 2. Rafter, T. A. (comp.). Wellington, New Zealand; Royal Society of New Zealand (1972).

From international radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972). See CONF-721019-(P2).

The ^{14}C dating standard used is the National Bureau of Standards Oxalic Acid. Craig (1961) reports a range in ^{13}C/^{12}C ratios from ca. $-18‰$ to ca. $-31‰$ with a mean value of $-19.6‰$ w.r.t. PDB for oxalic acid CO_2 produced by 13 different laboratories. Because of these differences in δ^{13}C values, Broecker and Olson (1961) proposed that all radiocarbon dating laboratories normalize standard oxalic counting gas to $-19‰$ and relate 0.95 × the measured activity of oxalic to the radiocarbon activity of 1890 A.D. wood (age corrected to 1958 A.D.). The range of possible δ^{13}C variations is in fact in excess of $\pm 50‰$ w.r.t. PDB. Grey et al. (1969) reported values of $+61.5‰$ for ca. $0.6‰$ of last fraction of CO_2 prepared from oxalic acid and Polach and Krueger (this conference) have experimentally established that δ^{13}C values range from $-50‰$ to $+54‰$ for significant proportions of CO_2 gas resulting from permanganate oxidation of oxalic acid. This could be of serious consequence to laboratories without access to mass spectrometric ^{13}C/^{12}C ratio determinations, because the error in ^{14}C activity of oxalic acid based on an assumed $-19‰$ δ^{13}C, may become rather large. Notwithstanding this, a cross checking of oxalic values and secondary standards conducted by Polach (this conference) indicated an excellent overall agreement between selected laboratories and confirmed the value and validity of using oxalic acid as a primary dating standard (none of the originally used 1890 wood now being available). Nevertheless a reevaluation of the pre-industrial ^{14}C level in the atmosphere has been seen to be important and Bannister and Damon (this conference) prepared a dendrochronologically derived primary standard for radiocarbon dating based on 1846 to 1855 tree rings. This primary standard is compared to oxalic acid, as well as to the ANU-Sucrose, which Polach and Krueger (this conference) have established to have a stable carbon isotopic composition within the range of $-11 \pm 2‰$. Preliminary results of this intercomparison are presented to this conference. (auth)

8720 HOW WELL LOGS CAN BE MISINTERPRETED. Hammack, G. W. (Continental Oil Co., Houston, TX); Fertl, W. H. World Oil; 179: No. 7, 69–73(Dec 1974).

Realistic evaluation of subsurface formations is obtainable from well logs, provided they have been properly run. Erroneous conclusions may easily be drawn if the geologist is unaware of anomalous features which may appear on logs. (auth)

8721 THE EFFECT OF THE ROCK PHYSICAL PROPERTIES ON THE GAMMA-RADIATION ABSORPTION PROCESS. Malakhov, G. M.; Sotskij, A.R.; Azaryan, A. A. (Krivorozhskij Gornorudnyj Inst. (USSR)). Izv. Vyssh. Ucheb. Zaved., Gorn. Zh.; No. 6, 3–6(1973). (In Russian).

3 figs.; 1 table.

Questions concerning the intensity of the γ radiation passing through the rock samples as a function of their physical-mechanical (elastic) properties were examined. The results showed the presence of a close bond between the elastic characteristics of the rocks and the intensity of the γ radiation passing through. This simplifies the methods for the evaluation and determination of the elastic properties of rocks. (tr-auth)

8722 DISTRIBUTION OF NEUTRONS FROM A STATIONARY POINT SOURCE IN A HOMOGENEOUS BED CROSSED BY A BOREHOLE. Kozachok, I. A.; Kulik, V. V.; Pirogov, V. I. (AN Ukrainskoj SSR, Kiev. Inst. Geofiziki). Geofiz. Sb., Akad. Nauk Ukr. SSR, Inst. Geofiz.; No. 53, 86-93(1973). (In Russian).
10 refs.

The thermalization of neutrons from a point source in two media with cylindrical line of separation was examined. The equation for the thermalization of neutrons obtained from the P_2 approximation of the method of spherical harmonics with less rigid limitations than older approximations was used during the solution. The actual media were replaced by some effective media characterized by their averaging of the neutron parameters according to energy in the complete thermalization interval. Formulas were obtained for the distribution of neutrons in these media suitable for numerical calculation on a computer. (tr-auth)

8723 SOME RESULTS OF NEUTRON-GAMMA LOGGING OF OIL- AND GAS FORCE-OUT UNDER CONDITIONS OF THE VOLGOGRADSKAYA REGION DEPOSITS. Goev, Yu. A.; Pinkenzon, D. B. (Volgogradskij Nauchno-Issledovatel'skij i Proektnyj Inst. Neftyanoj Promyshlennosti (USSR)). Nefteprom. Delo; No. 1, 7-10(1973). (In Russian).
2 figs.

The results of neutron-gamma logging during mutual ejection of petroleum and gas for the Volgodradskaya deposit are reported. With the neutron-gamma method it is possible to observe the processes of ejection of petroleum with gas and of gas with petroleum in stratified conditions. (tr-auth)

8724 INTRODUCTION OF PULSED NEUTRON–NEUTRON WELL LOGGING AT THE GAS–PETROLEUM DEPOSITS OF THE VOLGOGRAD REGION. Golovin, V. I.; Goev, Yu. A.; Pinkenzon, D. B.; Osechko, V. K.; Vyazun, V. P. pp 101-107 of Improving Geochemical and Geophysical Techniques on the Exploration of Petroleum and Gas in the Volgograd Region Povolzh'e. Proceedings of the Volgograd NIPINeft'. Volgograd, USSR; Nizhne-Volzhskoe Knizhnoe Izdatel'stvo (1973). (In Russian).
3 refs.; 2 figs.

Possibilities of increasing the temperature stability and operability of commercially available equipment IGN-1 and IGN-1M are demonstrated. A technique of borehole studies and the interpretation of INNM data from the Mirnovskii and Gakhmet'evskii deposits are presented. From the high efficiency of the pulsed neutron–neutron method in determining the water-oil contact region it is possible to recommend this method for separating terrigenic collectors according to oil–water–saturation. (tr-auth)

8725 SOME PRACTICAL APPLICATIONS OF RADIOACTIVITY SCIENCE IN PROSPECTING ESSENTIAL FOSSILS. Ul'ina, T. D. pp 238-252 of Radioactivity Science. Moscow; Nauka (1973). (In Russian).
71 refs.

The history of the domestic study on the use of radioactive radiation and neutrons in the search for minerals is examined. (tr-auth)

8726 STATISTIC CALIBRATION OF CURVES OF THE RADIOMETRY UNDER CONDITIONS OF SULFATE–CARBONATE CROSS-SECTION. Goeva, M. E. pp 96-100 of Improving Geochemical and Geophysical Techniques on the Exploration of Petroleum and Gas in the Volgograd Region Povolzh'e. Proceedings of the Volgograd NIPINeft'. Volgograd, USSR; Nizhne-Volzhskoe Knizhnoe Izdatel'stvo (1973). (In Russian).
4 refs.; 2 figs.

A method of reducing radiometric curves to unit borehole conditions in the absence of exposed reference strata in the cross-section under study is disclosed. The efficiency of the static calibration is noted in comparison with the technique of two reference strata (not exposed along the areal extent). It is shown that this method decreases the error of determining the porosity by 15–30%. (tr-auth)

8727 GAMMA SPECTROMETRY OF DEEP-SEA CORES AND SEDIMENT ACCUMULATION RATES. Cochran, J. K.; Osmond, J. K. (Florida State Univ., Tallahassee). Deep-Sea Res. Oceanogr. Abstr.; 21: No. 9, 721-737(Sep 1974).

Deep-sea sediment accumulation rates can be determined by nondestructive gamma spectrometry with about as much confidence and with far less effort than by radiochemical alpha spectrometry. Both methods are based on the decay of ^{230}Th within the sediment column, sometimes normalized against ^{232}Th; with the gamma technique, the isotopes actually measured are ^{214}Bi, a daughter of ^{230}Th, and ^{208}Tl, a daughter of ^{232}Th. Comparison of alpha and gamma measurements on four cores from the South Indian Basin shows that near the tops of some cores ^{214}Bi is not in equilibrium with ^{230}Th, partly because of diffusion of the intervening daughter, ^{226}Ra. If ^{214}Bi is assumed to be equilibrium with ^{226}Ra, a value for the diffusion coefficient of radium in sediments is determined to be in the order of 10^{-9} to 10^{-8} cm^2 s^{-1}, in agreement with previous results. Because such zones of diffusion are shallow compared to the total region of ^{230}Th decay in the sediment, there is little effect on the apparent sediment accumulation rate as determined by the decrease in the ^{214}Bi/^{208}Tl activity ratio down the core. (auth)

8728 ORIGIN OF MICROMANGANESE NODULES DETERMINED FROM URANIUM-234/URANIUM-238 RATIOS. Immel, R. L. (Florida State Univ., Tallahassee). Antarct. J. U. S.; 9: No. 5, 259-260(1974).

Data are presented which show that the ^{234}U/^{238}U activity ratios in micromanganese nodules separated from a deep sea clay core, obtained at 1886 fathoms in the South Pacific during a USNS Eltanin cruise, suggest a diagenetic origin for the concretions. (auth)

Site Surveys

Refer also to abstract 8738.

8729 (TID-26669-P1) BIOLOGICAL SURVEY OF THE SAVANNAH RIVER IN THE VICINITY OF THE SAVANNAH RIVER PROJECT. Part I. Report on Work Done and Tentative Conclusions on the Summer Survey. (Academy of Natural Sciences of Philadelphia, Pa. (USA). Dept. of Limnology). 24 Sep 1951. 30p. Dep. NTIS $4.50.
For Savannah River Plant, Aiken, SC.

The Savannah River is a normal river of low biological productivity. This limited life is due to physical circumstances causing unfavorable ecological conditions rather than pollution. The only noticeable effects of pollution resulting from the Augusta sewage, are the very high bacteria and coliform counts. Upper Three Run also shows a similar condition, which is probably due to the trailer camp and swimming area which is located at and just above the station. Although the fauna and flora of the Savannah River is limited it is of such a composition and size that the effects of organic and inorganic effluents can be ascertained. (auth)

8730 (TID-26669-P2) BIOLOGICAL SURVEY OF THE SAVANNAH RIVER IN THE VICINITY OF THE SAVANNAH RIVER PROJECT. Part II. Report on Work Done and Tentative Conclusions on the Fall Survey. (Academy of Natural Sciences of Philadelphia, Pa. (USA). Dept. of Limnology). [nd]. 46p. Dep. NTIS $5.50.
For Savannah River Plant, Aiken, SC.

The Savannah River in the vicinity of the Savannah River Project as measured by its diversity of species is a healthy natural river. Certain adverse ecological factors limit its productivity, but it has a well balanced biodynamic cycle. The results of the fall survey substantiate for the most part the conclusion of the summer survey. The main deviation is that for some groups it seems more productive than had been thought at first. Upper Three Runs is also a natural stream with a well balanced pattern of life. (auth)

8731 (TID-26669-P3) BIOLOGICAL SURVEY OF THE SAVANNAH RIVER IN THE VICINITY OF THE SAVANNAH RIVER PROJECT. Part III. Report on Work Done and Tentative Conclusions on the Winter Survey. (Academy of Natural Sciences of Philadelphia, Pa. (USA). Dept. of Limnology). Apr 1952. 61p. Dep. NTIS $6.25.
For Savannah River Plant, Aiken, SC.

The Savannah River during the third survey was studied under winter conditions. The total amount of aquatic life was probably much the same for most groups at this time as during the time of the previous surveys. High water and the resulting ecological conditions caused a decrease in the numbers of organisms collected and the apparent population was less. There had been an apparent seasonal change in species in most of the groups. However, in the case of the insects and fish this was more apparent than real, for during the previous surveys the organisms had been too small to be readily collected. Among the algae there had been an actual change in the common species. The number of species in the various groups remained quite comparable. According to our method of measuring the health of a river all stations continued to be rated as "healthy". (auth)

8732 (TID-26671) SAVANNAH RIVER BIOLOGICAL SURVEY. South Carolina and Georgia: Progress Report, August 1954. (Academy of Natural Sciences of Philadelphia, Pa. (USA). Dept. of Limnology). May 1955. 62p. Dep. NTIS $6.25.

For Savannah River Plant, Aiken, SC.

The purpose of this study was to determine the effects on aquatic life of the functioning of Clark Hill Dam. Methods used in previous surveys were followed. This investigation was made at the end of August 1954. The results indicated a considerable increase of life in the river both as to numbers of species and size of populations. This increase was especially notable as compared with the summer survey made in 1951. Only in the invertebrate fauna was there no conspicuous change in total populations. The operation of the dam has reduced the silt load and stabilized the water flow. Clearer water deepened the photosynthetic zone. The resultant greatly increased growth of plants is furnishing more food for animals. The more stable water level has enabled many of the shallow-water areas to be occupied continuously by a variety of organisms. The banks of the river, which had been continually eroding, have become more stabilized. No deleterious effects from the operation of the Savannah River Projects were observed. At the stations studied the Savannah River is classified as healthy. (auth)

8733 (TID-26672) EFFECTS OF HIGH TEMPERATURE ON CATFISH. (Academy of Natural Sciences of Philadelphia, Pa. (USA). Dept. of Limnology). Aug 1955. 19p. Dep. NTIS $4.00.

The upper temperature tolerances of two species of catfish, the southern channel catfish (Ictalurus lacustris punctatus) and the brown bullhead (Ameiurus nebulosus) were determined. Both of these species were found in the Savannah River in the vicinity of the Savannah River Project during the field studies conducted by the Academy. Groups of ten fish were subjected to a gradual increase of not more than one degree Centigrade per day up to various maxima, where they were maintained. Under these circumstances the channel catfish was able to survive for 40 days at a temperature of 32°C. The brown bullhead was somewhat more tolerant, being able to withstand a temperature of 34°C for a period of 40 days. These figures are for complete survival of the test group. Both species of catfish were also subjected to shock tests in which the temperature was raised many degrees within a few minutes. Both species survived for a short time at temperatures higher than those which proved lethal over a longer period of gradual acclimatization. However, when test organisms were maintained for 40 days after a shock test at either the final shock temperature or at the initial temperature, the upper limits for survival were very close to those obtained by gradual acclimatization. These results and those of other research conducted by the Academy indicate that, if a large portion of a river will be affected, temperatures of over 30°C should be avoided whenever possible. (auth)

8734 (TID-26673) SAVANNAH RIVER BIOLOGICAL SURVEY: SOUTH CAROLINA AND GEORGIA PROGRESS REPORT, AUGUST–SEPTEMBER 1955. (Academy of Natural Sciences of Philadelphia, Pa. (USA). Dept. of Limnology). May 1956. 213p. Dep. NTIS $13.75.

For Savannah River Plant, Aiken, SC.

The purpose of these studies was to determine whether any change had occurred since the surveys of 1951–1952 in the aquatic life and general environmental factors in the Savannah River. All areas originally studied during 1951–1952 were restudied at approximately the same time during the late summer and spring. The first survey was made from Aug. 24 to Sept. 7, 1955, during the period of high temperature. The second was from May 6 to 22, 1956. The spring survey was necessary for an evaluation of the capacity of the aquatic organisms to mature and reproduce at rates that would insure a balanced population. Chemical and bacteriological analyses and the protozoan identifications were made in the field laboratory. Most of the species identifications other than protozoa were made in the Academy laboratories in Philadelphia. Specimens of all preservable species were deposited in the taxonomic collections of the Academy. During each of these surveys, four regions of the Savannah River and one region on Upper Three Runs, a small tributary, were studied intensively. Most of the specimens of plants and animals were identified to species. Histograms showing the general pattern of species diversity and the relative health of the river in 1955 and 1956 as compared with 1951–1952 are given. The results of the Savannah River studies made in 1955 and 1956 indicate a considerable improvement in the aquatic life of the Savannah River compared with the results of the summer survey of 1951 and the spring survey of 1952. The only group of organisms which seemed to be in poorer condition than at the time of the base line studies was the clams. The chemical and bacteriological analyses indicated small changes in some of the characteristics of the river water. However, they were not deleterious to the overall condition of aquatic life in the river. The fauna and flora of Upper Three Runs, a tributary of the Savannah River, were not in quite as good a condition in 1955 as in 1951. This change was most evident in the size of populations and to some extent in the number of species of algae, protozoa and fish. However, in the spring of 1956 the fish were the only group which showed a significant change. (auth)

8735 (UCRL–51687) IN-SITU PERMEABILITY ANALYSIS USING BAROMETRIC PRESSURE FLUCTUATIONS. Sherwood, A. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Nov 1974. Contract W-7405-eng-48. 18p. Dep. NTIS $4.00.

Methods of inferring in-situ permeability from measurements of barometric pressure fluctuations are reviewed. The technique has been used in air-saturated porous media at the Nevada Test Site. Possible application is discussed for a water-saturated coal outcrop. The underlying differential equation is derived and the requirements for linearity are shown, along with the conditions where the effect of gravity may be neglected. The analogy between pressure-wave propagation and signal propagation on an electrical transmission line is discussed. Transmission line methods are used to investigate reflections from the end of a finite path, leakage to the surroundings from permeable sidewalls, and the signal perturbations introduced by a sampling probe. A computer program is described to evaluate the response in radial flow to a step change in pressure. A comparison is made between pressure waves in radial and linear flow geometry. (auth)

Thermal Effluents

Refer also to abstract 8733.

8736 (BNL-19203) MODELS AND THE DECISION MAKING PROCESS: THE HUDSON RIVER POWER PLANT CASE. Hall, C. A. S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 19p. (CONF-740734-1). Dep. NTIS $4.00.

From conference on mathematics and the perturbations of ecosystems; Alta, Utah, USA (2 Jul 1974).

Results are presented of analyses of power plant effects on Hudson River striped bass based on data collected directly or under contract by the major utility involved. The following topics are discussed: life history patterns of estuarine-dependent organisms; computer model of striped bass life history; computer models of power plants for studies on effects of impingement, entrainment, thermal and chemical effluents on fish; effects of loss of progeny on fisheries; and decision-making results based on model results. (HLW)

8737 (SAN-807X4) INVESTIGATIONS OF PHYSICAL PROCESSES AFFECTING LEAF TEMPERATURE PROFILES AND PRIMARY PRODUCTION IN THE RED MANGROVE ECOSYSTEM. Miller, P. C. (San Diego State Univ., Calif. (USA). Dept. of Biology). 1974. Contract AT(04-3)-807. 5p. Dep. NTIS $4.00.

Studies were conducted on transfer of heat by radiation and transfer through vegetation canopy, transfer of heat by individual leaves, and processes of water uptake and photosynthesis in red mangroves. Measurements were made on species of Rhizophora, Avicennia, and Laguncularia in south Florida. Studies were also conducted on simulations of the effect of heated effluents on vegetation. (HLW)

8738 (TID-26675) SAVANNAH RIVER BIOLOGICAL SURVEY OF LOWER THREE RUNS, SEPTEMBER–OCTOBER 1962. (Academy of Natural Sciences of Philadelphia, Pa. (USA). Dept. of Limnology). 1962. 66p. Dep. NTIS $6.50.

For Savannah River Plant, Aiken, SC.

The purpose of this survey was to determine whether any physical, chemical, or biological changes had occurred at the Millet-Martin Station on Lower Three Runs since the last survey there in September, 1961. This survey was undertaken during the period of low flow and warm water conditions, when the environment is least favorable for aquatic life. Just as in 1961, there was evidence of damage to Station L3R. This was particularly evident when the results were compared with the 1960 survey, and was most evident in the insect fauna. The lower invertebrates remained much as they were in 1961, but still showed signs of degradation, as evidenced by restriction in both diversity of species and population densities. The fact that there was an abundant food supply for the lower invertebrates indicates that the restrictions must have been due to some source other than food. Contrary to the conditions at Station L3R in 1961, the Protozoa had increased considerably in species density. This indicates the possibility that some of the restricting influence may not now be acting. In the algae, a 50 per cent composite count for Gomphonema parvulum, and the abundance of Stigeoclonium lubricum and Spirogyra indicates considerable organic enrichment. Station TCR remained essentially the same as it was in 1961 with regard to the algae. (auth)

8739 (TID-26686-P1) METEOROLOGICAL EFFECTS OF THE COOLING TOWERS AT THE OAK RIDGE GASEOUS DIFFUSION PLANT. I. Description of Source Parameters and Analysis of Plume Photographs and Hygrothermograph Records. Hanna, S. R.; Perry, S. G. (National Oceanic and Atmospheric Administration, Oak Ridge, Tenn. (USA). Atmospheric Turbulence and Diffusion Lab.). Dec 1973. 42p. Dep. NTIS $5.25.

Measurements of source parameters, downwash criteria, visible plume dimensions, and water deposition rate, taken at the Oak Ridge Gaseous Diffusion Plant are presented. In some cases, such as the measurements of the initial droplet size distribution, comparisons are made with similar measurements taken by other groups. The most significant findings are listed in the summary at the end of the report. (auth)

8740 (TID-26686-P2) METEOROLOGICAL EFFECTS OF THE COOLING TOWERS AT THE OAK RIDGE GASEOUS DIFFUSION PLANT. II. Predictions of Fog Occurrence and Drift Deposition. Hanna, S. R. (National Oceanic and Atmospheric Administration, Oak Ridge, Tenn. (USA). Atmospheric Turbulence and Diffusion Lab.). Mar 1974. 41p. Dep. NTIS $5.25.

The frequency of occurrence of fogs and the rate of deposition of chromate due to emissions from the cooling towers at the Oak Ridge Gaseous Diffusion Plant are calculated. Observations of drift deposition agree fairly well with calculated values. A detailed summary of significant findings is given at the end of the report. (auth)

8741 EFFECTS OF THERMAL EFFLUENT ON THE POPULATION DYNAMICS OF HELMINTH PARASITES OF THE LARGEMOUTH BASS, MICROPTERUS SALMOIDES. Eure, H. E. Winston-Salem, NC; Wake Forest Univ. (1974). 109p. University Microfilms Order No. 74-24,457.

Thesis (Ph. D.).

The objectives of this study were: to identify the intestinal parasite fauna of fish from a thermally altered reservoir; to determine the effects of the heated effluent on the seasonal incidence and intensity of parasitic infections; and, to examine the effects of worm burdens on the fish host. The acanthocephalan, Neoechinorhynchus cylindratus, showed a pronounced seasonal cycling pattern in intensity of infection, but the incidence remained relatively constant throughout all seasons. Significant differences were noted in the mean number of parasites per host in fish taken from heated areas as compared to those from unheated areas. Female bass were more heavily parasitized during every season regardless of the location. The cestode, Proteocephalus ambloplitis, also showed a change in the number of parasites per host in relation to season. Plerocercoids were found throughout the year in all areas, while adults were only present during the winter and spring of the year. Female bass had both a higher incidence of cestode infections and a higher mean number of worms per infection. Three trematodes, Pisciamphistoma stunkardi, a neascus of Posthodiplostomulum minimum and a larval Diplostomulum were also found in the bass. Metacercariae of P. stunkardi were present during the summer, fall and early winter, but disappeared completely with the advent of colder winter temperatures. Adult stages of P. stunkardi were not seen in any great numbers until fall and winter. The acanthocephalan species accounted for approximately 98% of the total parasite population. Therefore, it was studied in more detail to determine any seasonal fluctuations occurring in that infrapopulation (infrapopulation being defined as all of the members of a single species within a given host). There appeared to be three waves of input into the enteric Neoechinorhynchus infrapopulation. A heavier, more concentrated input was noted in the fall and winter, while a reduced input was recorded for the early summer. The summer recruitment was negligible with respect to the total number of acanthocephalans present during the summer, since the vast majority of the worms were in the three to eight mm size class and the density of the worm population was low. (Diss. Abstr. Int., B)

Chemical Effluents

Refer also to abstracts 8736 and 10455.

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 8811 and 8878.

General Detectors and Monitors

Refer also to abstracts 8692, 8784, 8804, 8869, 8987, 9044, 9610, 10157, and 10342.

8742 (GKSS-74/E/32) NS OTTO HAHN: RESEARCH REPORT NO. 7. Determination of the Relative Neutron Sensitivities by Vanadium Self-Powered Neutron Detectors in the FDR by Noise Analysis. Boettcher, G.; Robinson, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1974. 14p. (In German). Dep. NTIS (US Sales Only) $4.00.

Measurements are described in which the relative neutron sensitivities of V self-powered neutron detectors were determined by a method proposed by W. Seifritz. The relative neutron sensitivities were determined from the phase of the spectral cross power density between a prompt response neutron flux detector and the self-powered neutron detectors. (tr-auth)

8743 (JINR-P15-8185) METHOD OF CALCULATION OF THE DETECTOR RESOLUTIONS USED IN (ΔE,E) TECHNIQUE FOR IDENTIFICATION OF THE PRODUCTS OF NUCLEAR REACTIONS ON HEAVY IONS. Zorin, G. N.; Glushkovskii, M. E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 26p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

A method is suggested for calculation of the energy resolutions necessary for detectors used in the (ΔE,E) technique for identification of the products of nuclear reactions on heavy ions. The experimental results are presented that confirm the calculations performed by this method. (auth)

8744 NOISE IN FILLING PROPORTIONAL COUNTERS. Chrapan, J. (Katedra Jadrovej Fyziky, Bratislava). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; 8: 217-226(1973). (In Slovak).

The mechanism responsible for noise effects arising after a filling of a proportional or Geiger–Mueller counter is described. (auth)

8745 IMPROVEMENTS IN OR RELATING TO NUCLEAR PARTICLE RESPONSIVE ARRANGEMENTS. White, G. (to United Kingdom Atomic Energy Authority). British Patent 1,359,883. 17 Jul 1974. 5p.

The arrangement described comprises a particle detector having a variable collection time, signal shaping means, and control means arranged to block application of each signal to the shaping means for a predetermined time that is longer than the greatest collection time of the detector after which substantially the whole of the remaining part of the signal is fed to the shaping means. Details are given of the control means, timing and delay means, switching arrangements, and shaping means. (UK)

8746 IMPROVEMENTS IN OR RELATING TO RADIATION CHECK SOURCES. Kemp, L. A. W. E. British Patent 1,359,322. 10 Jul 1974. 5p.

The object is to provide a check source of ionizing radiation for ionization chambers that is integral with the chamber, being operationally positioned at the center of the collecting electrode and which can be safely located when not in use. An enclosure adjacent to the chamber houses the check source and a track is provided between the enclosure and the chamber, along which the check source can move under gravity by tilting the apparatus. A catch is preferably provided to prevent movement of the source out of the enclosure in order to allow the chamber to be used with the track in a non-horizontal position. Such a catch is also desirable for safety reasons. In an ionization chamber having a collecting electrode mounted on a hollow stem this stem can be used as the track, with a slidable mounting for the check source. The releasable catch may be magnetically operated. Americium-241 may be used as the check source. (UK)

8747 PROPOSED γ CAMERA. Todd, R. W.; Nightingale, J. M.; Everett, D. R. (Univ. of Southampton, Eng.). Nature (London); 251: No. 5471, 132-134(13 Sep 1974).

A new approach to γ-ray imaging is described, which appears to offer considerable advantages over existing systems; scanners or cameras can be used. The scanner has a detector head consisting of a scintillation crystal, a photomultiplier, and a lead diverging hole collimator, and the complete image forming process can take up to 30 minutes. In camera systems the collimated detector must cover the entire investigation region. Mechanical scanning is not used and the scintillation positions are detected using an array of photomultipliers. The interactions used in image formation are single absorption processes resulting from the photoelectric effect. In both scanner and camera systems speed can be increased by using greater isotope activity, but with a lead collimator only a small fraction of the incident radiation is useful. Also, with low energy isotopes there is considerable scattering within the examined region, and there are inherent limitations in resolution and sensitivity. A theoretical analysis is given of the operation of the system. Sources of error are enumerated. The use of liquid or solid scintillators, proportional chambers, and semiconductor detectors would be suitable. A prototype is under construction. Data processing is an integral part of the optical system. (UK)

8748 PERFORMANCE OF A COAXIAL GERMANIUM GAMMA-RAY CAMERA. Strauss, M. G.; Sherman, I. S.; Brenner, R.; Lenkszus, F. R. (Argonne National Lab., IL). J. Nucl. Med.; 15: No. 12, 1196-1200(Dec 1974).

The inherent spatial resolution of a prototype coaxial Ge gamma-ray camera was measured by irradiating a lead test pattern with gamma rays from a ^{57}Co source. The 10-mCi source was 70 cm from the detector. The test pattern consisted of bars, disks that simulate "cold" lesions, and holes that simulate "hot" lesions. The widths and spacings of the bars and the diameters of the disks and holes range from 1 to 4 mm. A period of 10 min was adequate to obtain an image in which the smallest features were clearly discernible. The insertion of 5 cm of tissue-equivalent scattering material (Plexiglas) between the detector and the test pattern had no perceptible effect on the quality of the image, not even on the 1-mm "cold" spot. Energy resolution (FWHM) of 1 keV permits full efficiency to be obtained with a single-channel analyzer window of only 2 keV (1.6%). The dual-isotope technique was simulated by simultaneously imaging ^{57}Co (136 keV, identical to ^{75}Se) and ^{99m}Tc (140 keV). Although the energies are only 4 keV apart, the two images were completely separated without sacrificing counting efficiency. (auth)

8749 THEORETICAL PREDICTION OF THE GEOMETRIC TRANSFER FUNCTION FOR FOCUSED COLLIMATORS. Metz, C. E.; Tsui, M. W.; Beck, R. N. (Univ. of Chicago). J. Nucl. Med.; 15: No. 12, 1078-1083(Dec 1974).

The transfer function describing spatial resolution characteristics of a focused collimator used in conventional scanning can be described by the weighted sum of three terms representing contributions of geometrically collimated, penetrating, and scattered radiation. The present work has shown that the geometric component of the transfer function of a single-hole or multihole focused collimator with round holes packed in an hexagonal array can be expressed in the form of a rather simple equation involving trigonometric functions, first-order Bessel functions, and the physical dimensions of the collimator. This expression is applicable for any collimator-to-source distance and takes into account the directional dependence of geometric resolution due to hole-packing geometry. Fourier transformation of line spread functions measured using a thin-walled line source of ^{125}I in air, in which case scatter and septal penetration can be neglected, has shown that the predicted transfer functions are accurate to within a few percent over a broad range of spatial frequencies and collimator-to-source distances. Thus the theoretical approach appears to provide a powerful tool for the designing of focused collimators. (auth)

8750 IMPROVED DATA RECORDER FOR SCINTILLATION CAMERAS. Bliss, R. D.; Weber, P. M.; dos Remedios, L. V. (Riverside Bio-Engineering, CA). J. Nucl. Med.; 15: No. 12, 1130-1134(Dec 1974).

A tape-recording system using a variation of pulse-width modulation records up to 28,000 Hz from an Anger camera without spatial or temporal distortion and with less than 1% data loss. Recording and playback may be made at any of five tape speeds: 3¾, 7½, 15, 30, 60 ips, each accommodating a different maximal counting rate. Since only two of four recording tracks are used, the others are available for other input. The replayed data appear in a format identical to the gamma camera signal; hence, any data manipulation performable on the original signal can be carried out on the replay. The system has advantages over other gamma camera recording systems: matrix artifact is eliminated; replay time may be accelerated or decelerated depending upon study objectives; when data are digitized for computer manipulation, data losses caused by deadtime are limited to those intrinsic to the gamma camera itself. (auth)

8751 FLUCTUATIONS OF IONIZATION LOSSES IN PROPORTIONAL CHAMBERS. Onuchin, A. P.; Telnov, V. I. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Nucl. Instrum. Methods; 120: No. 2, 365-368(1 Sep 1974).

There is no theory describing the fluctuation of the ionization losses at very small absorber thicknesses. Experimental widths of ionization-loss distribution measured with proportional chambers are presented. (auth)

8752 AN ADAPTATION OF THE PULSER METHOD FOR THE DETERMINATION OF LOSSES IN COUNTING SHORT-LIVED NUCLIDES. Goerner, W. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Nucl. Instrum. Methods; 120: No. 2, 363-364(1 Sep 1974).

Dead-time and decay losses and/or irradiation doses can automatically be taken into consideration with the help of a pulser which is externally triggered by a decay corrector or a monitor channel, respectively. (auth)

8753 TIME RESOLUTION IN X-RAY–HEAVY-ION COINCIDENCE MEASUREMENTS AS A FUNCTION OF THE X-RAY ENERGY. Schmidt-Boecking, H.; Tserruya, I.; Zekl, H.; Bethge, K. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). Nucl. Instrum. Methods; 120: No. 2, 329-332 (1 Sep 1974).

The time resolution for a Si(Li) detector–surface barrier detector system in x-ray–heavy-ion coincidence measurements has been measured as a function of the x-ray energy from 2.2 to 22 keV. For low x-ray energies E_x, the time resolution is proportional to E_x^{-1}. For $E_x > 10$ keV the time resolution measured is better than 10 ns. The results presented indicate that differential cross-section measurements of inner-shell ionization induced by heavy particles can be performed with high accuracy in relatively short measuring times. (auth)

8754 POSITION-DETERMINING SCINTILLATOR. Arens, J. F. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Nucl. Instrum. Methods; 120: No. 2, 275-279(1 Sep 1974).

Pulse-height measurements of the signals of two or more photomultiplier tubes looking at a thin scintillator system can be used to determine the position of the light-producing region. Calculations for a system of photomultiplier tubes directly coupled to a scintillator are presented. Locations of tracks of heavily ionizing particles are calculated to be accurate to within $\lesssim 1$ cm over an area of ~ 1 m^2 for reasonably shaped systems. (auth)

8755 PULSE-SHAPE DISCRIMINATION APPLIED TO THE SCINTILLATING-TARGET TECHNIQUE. von Moellendorff, U.; Slobodrian, R. J. (Laval Univ., Quebec City (Canada). Dept. de Physique). Nucl. Instrum. Methods; 120: No. 2, 257-259(1 Sep 1974).

The application of pulse-shape discrimination to scintillating targets used for fast-neutron scattering is discussed. Experimental results are presented which show that useful time-of-flight spectra can be obtained from n-p scattering in a considerable γ flux, and that pulse-shape discrimination of carbon recoils against γ counts is possible in a NE 226 liquid scintillator. (auth)

8756 THE PLASMA EFFECT IN SILICON SEMICONDUCTOR RADIATION DETECTORS. Williams, R. N.; Lawson, E. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Instrumentation and Control Div.). Nucl. Instrum. Methods; 120: No. 2, 261-268(1 Sep 1974).

The plasma effect in high-purity silicon nuclear radiation detectors, up to 1 mm thick, has been investigated by observing current pulses produced by these detectors when bombarded by ^{241}Am 5.5 MeV alpha particles. The pulses were used to measure plasma times (typically 5 to 40 ns) for applied fields 0.5 to 3 kV cm^{-1} at temperatures from 300 to 80°K. The plasma time was found, in agreement with earlier workers, to vary inversely with electric field acting on the plasma column, and to be roughly independent of detector thickness. However, it varied as the square of the temperature between 300 and 160°K, a much stronger dependence than previously reported. The current pulse shapes were found to exhibit a slow component in their risetime which was attributed to the dispersal of the plasma. The length of this component was found to be similar to the plasma time. A simple interpretation of the pulses suggests that this length is a more meaningful parameter with which to characterise the plasma effect. (auth)

8757 A NEW TECHNIQUE FOR THE MEASUREMENT OF PHOTONEUTRON ANGULAR DISTRIBUTIONS. Patrick, B. H.; Bowey, E. M. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nucl. Instrum. Methods; 120: No. 2, 245-249(1 Sep 1974).

A new technique for the measurement of photoneutron angular distributions using track detectors is described. Makrofol-uranium-Makrofol sandwiches are placed around the sample being studied. Fission fragments, produced by fast-neutron interactions in the uranium, damage the Makrofol, and by counting these tracks angular distributions can be obtained. A measurement of the photo-disintegration of deuterium serves to demonstrate the technique. (auth)

8758 STRAIGHT-SECTION APPROXIMATION FOR THE RANGE FUNCTION IN A PARTICLE IDENTIFIER. Sluiters, J. E.; Klein, S. S. (Technische Hogeschool Eindhoven (Netherlands)). Nucl. Instrum. Methods; 120: No. 2, 305-308(1 Sep 1974).

In a differential-range particle identifier one needs a function generator with an output proportional to the range R(E) of particles with energy E. When the function R(E) is approximated by a sufficient number of straight sections one is not restricted by the properties of analogue elements in choosing the approximation. A temperature-insensitive switch circuit was developed using one-chip diode arrays, and incorporated in the function generators of a particle identifier whose speed (300 ns) is only restricted by the operational amplifiers used. The circuit should also be useful to supply analogue computers with other functions of positive curvature. (auth)

8759 IMPROVED RADIATION DETECTING APPARATUS. Spleha, D. J.; Kreuser, M. J. (to Nuclear Corp. of America). South African Patent 111,409. 31 Jan 1972. Priority Date 1 Feb 1971, USA. 29p.

A light guide for improving the accuracy of locating and indicating the intensity of a radiation source using two-dimensional coordinates in a radiation detecting apparatus is described. The system comprises a first surface having a highly transparent area for intimate contact with a face of scintillating crystal assembly, a second surface having highly transparent areas for intimate contact with the light sensitive faces of photomultiplier tubes, a boundary surface joining said first and second surfaces, and a highly light absorbent coating on the light guide surrounding the aforesaid highly transparent areas. (INIS)

Radiation Dosimeters

Refer also to abstracts 9305, 10144, and 10294.

8760 (AD-783779) FOIL ACTIVATION ANALYSIS AND THERMOLUMINESCENT DOSIMETRY ON SKYLAB II. Final Report, April 1973–July 1974. Wailly, L. F.; Watters, J. W.; Carter, P. B. (Air Force Academy, Colo. (USA)). Jul 1974. 27p. (USAFA-TR-74-11). NTIS $3.25.

The Skylab II command module was equipped with passive dosimeters located at five selected stations within the spacecraft to monitor radiation levels accumulated during the 28 day space mission. The passive sensors consisted of an array of thermoluminescent devices (TLD), ionization chambers, and activation foils. The thermoluminescent units chosen were the EG and G corporation evacuated glass container type. Both lithium fluoride and manganese activated calcium fluoride were selected for use in the Skylab missions. (GRA)

8761 (SZS-157, pp 159-168) INTRODUCTION OF THERMOLUMINESCENCE DETECTORS FOR ENVIRONMENTAL MONITORING OF NUCLEAR INSTALLATIONS. Will, W. Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The sensitivity, fading behavior, and glow curves of LiF powder, CaF_2 : Mn powder, CaF_2 : Mn imbedded in teflon, $CaSO_4$: Dy powder, and $CaSO_4$: Mn powder (possible components of thermoluminescent detectors) were measured and some of the results are shown in graphic and tabular form. The results show that detectors with $CaSO_4$: Dy and $CaSO_4$: Mn offer the most advantages for environmental monitoring. The combination of these two components in a single probe also has the advantage that the same filtering can be used in their capsulation. (JSR)

8762 LARGE RADIATION DOSIMETRY WITH PERSPEX. Kanazawa, T.; Ohnishi, T.; Hiraoka, E.; Furuta, J. Annu. Rep. Radiat. Center Osaka Prefect.; 14: 56-59(1973).

The effect of temperature during irradiation and the effect of scattered radiation on a Perspex dosimeter are studied. The optical density of Perspex is very much temperature dependent at high temperature and at high doses. The fading mode of irradiated Perspex is also much temperature dependent. The contribution of backscattered gamma-rays are predominant and the recorded dose when a scatterer is put behind Perspex shows a much larger value. (auth)

8763 ALTERING THE ENERGY DEPENDENCE OF LiF TLDs BY PRE–IRRADIATION. Mayhugh, M.R.; Fullerton, G.D. (Departments of Physics and Radiology, University of Wisconsin, Madison, Wisconsin 53706). Med. Phys. 1: No. 5, 275-276 (Sept 1974).

Energy dependences (thermoluminescent response to 30–130 keV$_{eff}$ x rays compared to that from ^{60}Co gammas) were measured for normal LiF dosimeters and for ones which had been sensitized by pre–irradiation (10^3-10^6R) followed by annealing near 300°C. Unsensitized LiF (Harshaw's TLD–100 and TLD–700) responds slightly higher (5–10%) to the x rays than expected from changes in dose. When LiF is radiation sensitized, the relative response decreases in the 30–135 keV$_{eff}$ range as much as 40% for pre–exposures $\gtrsim 10^5$ R. A commercial dosimeter (Radiation Detection Co. "throwaway powder") displays this altered energy dependence because the LiF is pre–exposed by the manufacturer. To emphasize the major point: Sensitization alters the energy dependence of LiF without any change in atomic number. Possible uses for this effect are discussed. (auth)

8764 CHLOROBENZOIC ACIDS (CBA) AS CHEMICAL DOSIMETERS FOR GAMMA RAYS. Shamdasani, N. K.; Rao, K. N. (Bhabha Atomic Research Centre, Bombay). Radiat. Eff.; 22: No. 3, 145-151(1974).

Aqueous solutions of o-chlorobenzoic acid, m-chlorobenzoic acid and p-chlorobenzoic acid become fluorescent on γ-irradiation. This fluorescence yield can be used for measurement of γ-dose. These three chlorobenzoic acid solutions have been examined for γ-dosimetry under different conditions of concentration, dose rate, pH of irradiation and pH of measurement. Ortho and meta chlorobenzoic acid solutions (10^{-3} M) can be used as γ-ray dosimeters between 5 to 30,000 and 50 to 30,000 rads respectively and p-chlorobenzoic acid solution of 10^{-3} M can be used between 50 to 10,000 rads. (auth)

8765 INTERNAL RADIATION DOSE MEASUREMENT USING HIGH SENSITIVITY FLUOROGLASS DOSIMETER. I. Yamaguchi, C.; Toyama, H.; Iio, M.; Yamada, H. (Tokyo Metropolitan Geriatric Medical Center). Radioisotopes (Tokyo); 23: No. 5, 275-281(May 1974). (In Japanese).

An improvement in the equipment for the fluorescence measurement of the fluoroglass dosimeter was obtained for medical internal dose measurements. This apparatus and the newly developed fluoroglass FD-6 made it possible for the 1 mm × 6 mm rod type fluoroglass element to measure the absorbed dose as low as 3 mrads. As one of the preliminary tests for the direct measurement of the internal dose of the human organs when the radiopharmaceutical is injected, a series of experiments using 13 rats was carried out. One or two glass rods were implanted in their livers. Immediately or about 40 days after the implantation of the glass elements, an amount of 3 to 5 μCi colloidal gold (^{198}Au) was injected in their veins with disposable injectors. Several glass rods were covered with 0.25 mm thick gold sheaths during the exposure to see the contributions of β and γ rays from ^{198}Au separately. The rods were taken out about 3 days after the injection of ^{198}Au. The radiophotoluminescence was measured with the equipment after several necessary processes for cleaning the glass rods. The results were compared with the calculated values based on the MIRD (Medical Internal Radiation Dose) Committee method. In the experiment using 500 ml water phantom, the experimental absorbed and calculated doses showed a good linear correlation, although the latter were 1.4 times larger than the former. The ratio of the contribution of β rays to the total absorbed dose was 0.81 ± 0.004 in the experiment and 0.84 in the MIRD calculation, showing good agreement with each other. In the experiment using 13 rats, however, the calculated absorbed dose values were 2 to 60 times as large as the experimental ones. The ratios of the contributions to the absorbed doses from β rays to those from γ rays did not show such large discrepancies between experiment and calculation. Discussions on this problem are given. (auth)

8766 ALPHA PARTICLE DOSIMETER. Alter, H. W.; Lovett, D. B. (to General Electric Co.). South African Patent 163,150. 19 Jun 1972. Priority Date 16 Jul 1971, USA. 17p.

An alpha particle dosimeter for recording alpha radiation comprising, in combination, (a) a housing having (1) a support slot capable of receiving an inserted tongue, (2) fastening means for locking the inserted tongue into the housing and (3) a protruding lip on the housing; and (b) an insert means having (1) a tongue capable of being inserted into the support slot of the housing and receiving means for receiving the fastening means of the housing in a tight connection and (2) groove means capable of receiving and holding a piece of track-registration film. (INIS)

8767 UP-TO-DATE DOSIMETERS IN THE PROTECTION AGAINST RADIATION INJURY. Boros, L. Magy. Radiol.; 26: No. 5, 305-313(Oct 1974). (In Hungarian).

The recent advances in the improvement of dosimeters based on solid body physics are outlined. The photo- and thermoluminescent, exoelectron, thermo-electret, and the electron spin resonance dosimeters, as well as the principles of the solid body track detectors and the solid body ionization cameras, their properties and their role in protection against radiation injury are discussed. (auth)

8768 USING THERMOLUMINESCENCE OF RUBY FOR THE DOSIMETRY OF γ-RADIATION. Yunusov, M. S.; Tsoi, A. N.; Muminkhodzhaev, K. M.; Khaimov-Mal'kov, V. Ya. Sov. At. Energy (Engl. Transl.); 36: No. 4, 396-398(Apr 1974).

Translated from At. Energ. (USSR); 36: No. 4, 315-317(Apr 1974).

Thermoluminescence was studied in samples of ruby with various concentrations of admixed chromium. The samples were cut in the form of plates with a diameter of about 10 mm and a thickness of 0.5 to 4 mm. The dose rate of the γ-radiation from a ^{60}Co isotope source was varied within wide limits (0.1 to 3.10^3 rad/sec). The thermal deexcitation of the crystals was recorded with an photoelectric attachment using an FEU-18 photomultiplier; the heating rate was constant and amounted to 0.16 deg/sec. The dependence of the intensity of ruby thermoluminescence upon the γ-radiation dose and the chromium concentration under various irradiation and measurement conditions was studied. Dosimeters on the basis of ruby have a higher light output and neither worse stability nor higher cost than LiF dosimeters. Apart from this, ruby is characterized by high mechanical and chemical resistance and stability of the dosimetric information obtained in repeated use of the dosimeter. These qualities suggest that the thermoluminescent properties of ruby be extensively used in the dosimetry of γ-radiation. (WHK)

Nuclear Spectroscopic Instrumentation

8769 (AD-777161) X-RAY EVALUATION OF CRYSTALS FOR STELLAR SPECTROMETERS. Report for October 1972–April 1973. Alexandropoulos, N. G. (Aerospace Corp., El Segundo, Calif. (USA)). 29 Mar 1974. Contract F04701-73-C-0074. 85p. (SAMSO-TR-74-83). NTIS $4.00.

The report consists of three parts. The first part is an analysis of the principles involved in x-ray crystal evaluation and how they are applied to a number of crystals. The principles of crystal evaluation analysis as they apply to the special problems of x-ray astronomy are presented. A number of crystals were evaluated, and the energy dependence of the diffraction properties of (002) PET, (111) GE, (101) ADP, (001) KAP, and (001) RAP are reported. The second part is a compilation of the diffraction properties of a number of crystals as reported by other authors. In the third part some technical details of a triple crystal spectrometer built by the author at Polytechnic Institute of Brooklyn are given. This spectrometer seems to be a most appropriate instrument for evaluation of crystal properties. (GRA)

8770 VERSATILE MULTIPLE MOESSBAUER SPECTROMETER. Window, B.; Dickson, B. L.; Routcliffe, P.; Srivastava, K. K. P. (Australian National Univ., Canberra). J. Phys., E (London); 7: No. 11, 916-921(Nov 1974).

A Moessbauer spectrometer system, based on a PDP 11/10 minicomputer and capable of accumulating up to eight simultaneous spectra, has been designed and constructed. The system allows the data in each spectrum to be handled without interference to the other accumulating spectra. The computer is used to generate the velocity reference signal, removing the need for a separate waveform generator, and enabling a very smooth waveform to be calculated and used. (auth)

8771 ENERGY RESOLUTION OF QUADRUPOLE LENSES FOR CHARGED–PARTICLE BEAMS. Siksin, V.S. Sov. Phys.–Tech. Phys. 19: No. 3, 301-307 (Sept 1974).

The energy resolution of a system consisting of a 90° deflecting magnet and a doublet of quadrupole lenses is found for arbitrary values of the field parameters of the individual lenses of the doublet. In three–dimensional (k_1, k_2, F) space the energy resolution function F(k_1, k_2) is represented by a surface. Cross sections of this energy resolution surface made by planes perpendicular to the plane of its base (k_1, k_2) which pass through the origin form a family of characteristic curves with maxima. The values of the energy resolution are the same at these maxima, being equal to the energy resolution of the beam produced by the deflecting magnet alone. It is established that the necessary and sufficient condition for the preservation and reproduction of a chosen energy resolution curve of the beam, and thus the preservation and reproduction of the value of the energy resolution for a change in the field parameters k_1 and k_2 of the individual lenses of the doublet, is the preservation of a constant value of k_1/k_2 equal to 1.02, 2.05, and 0.51, and cases "c" and "d" have been determined. The value of the energy resolution of a beam of protons in the regions of transition from a virtual to a real image of the object (beam crossover) for various values of k_1/k_2 does not depend on C, the distance from the exit lens of the doublet to the crossover plane, at which the energy resolution is determined. For k_1/k_2 equal to 1.02, 2.05, and 0.51, various distances C, and cases c and d differences are found in the effect of variations of the parameters k_1 and k_2 on the energy resolution. The energy resolution curves are compared for these cases. The values of the parameters k_{1max} and k_{2max} corresponding to the best value of the energy resolution are determined. The widths of these curves are found. (auth)

8772 ENERGY ANALYZERS: A STUDY OF THEIR ULTIMATE CAPABILITIES. Gellender, M. E.; Baker, A. D. (Queens Coll., New York (USA)). J. Electron Spectros. Relat. Phenomena; 4: No. 3, 249-262(Sep 1974).

A general equation is derived stating the limit of maximum transmission and resolution concurrently attainable based upon the nature of the source (its brightness and energy), the degree of space focussing and the maximum area focussed onto the image. The derivation does not presuppose any particular electrode configuration and is therefore discretely different from previous treatments. (auth)

8773 PROSPECTS OF RESEARCH ON γ-FIELDS OF ROCKS AND SOILS ON THE EARTH'S SURFACE WITH THE AID OF SEMICONDUCTOR DETECTORS. Ionov, V. A.; Kazakov, Yu. E.; Nazarov, I. M.; Patrakeev, S. I.; Sorokin, V. N.; Fridman, Sh. D. Sov. At. Energy (Engl. Transl.); 36: No. 4, 393-395(Apr 1974).

Translated from At. Energ. (USSR); 36: No. 4, 313-315(Apr 1974).

The possibility of Ge(Li) gamma spectrometry for airborne monitoring of natural deposits of uranium, thorium, and potassium is discussed. A 56 cm^3 Ge(Li) detector with a resolution of 4.8 keV at 1.33 MeV was used with a radiation shield having a half-angle of 70°. Calculated and measured results of the performance of the system are reported. (WHK)

8774 A COMPUTERIZED PIEZOELECTRIC MOESSBAUER SPECTROMETER. Schmidt, K. P.; Huyse, M.; de Raedt, J.; Langouche, G.; van Rossum, M.; Coussement, R. (Louvain Univ. (Belgium)). Nucl. Instrum. Methods; 120: No. 2, 287-291(1 Sep 1974).

A Mössbauer spectrometer has been developed consisting of a piezoelectric drive unit and a computerized data-acquisition part. The results of test measurements with ^{57}Fe at liquid-helium temperature and at room temperature are given. (auth)

8775 COMPLETE IDENTIFICATION OF HEAVY IONS BY MEANS OF A TIME-OF-FLIGHT SPECTROMETER WITH ΔE IONIZATION CHAMBER. Gamp, A.; Bohne, W.; Braun-Munzinger, P.; Gelbke, C. K. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). Nucl. Instrum. Methods; 120: No. 2, 281-286(1 Sep 1974).

A time-of-flight spectrometer with ΔE ionization chamber at the end of the flight path permits complete separation of different elements and isotopes in the region of A ~ 16 down to energies of 1 MeV/amu. (auth)

8776 A TIME-OF-FLIGHT FACILITY FOR THE MEASUREMENT OF ELECTRON-INDUCED NEUTRON SPECTRA. Schier, H.; Schoch, B. (Mainz Univ. (F.R. Germany). Inst. fuer Kernphysik). Nucl. Instrum. Methods; 120: No. 2, 269-273 (1 Sep 1974).

A time-of-flight facility is constructed to investigate photoneutrons in the energy range 5 MeV $\leq E_n \leq$ 200 MeV. Photoneutrons are detected simultaneously at four angles (40.2°, 90°, 113.5°, 142.2°). The overall time resolution varies from 0.282 ns/m to 0.358 ns/m, depending on the different flight paths (18.56 m to 11.40 m). As a first check the facility is used to measure the ratio of the number of virtual photons to real photons via the photodisintegration of ^{2}H. The measured values agree with the calculated photon spectra. (auth)

8777 A NEUTRON-SPECTRUM MONITOR WITH ANNULAR RADIATOR AND AXIAL RECOIL DETECTOR. Sidhu, G. S.; Czirr, J. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nucl. Instrum. Methods; 120: No. 2, 251-255 (1 Sep 1974).

A fast-neutron spectrum monitor characterized by high detection efficiency, simplicity, and low background has been used for measurements at the LLL electron linac. The detector system consists of an annular CH$_2$ radiator foil placed symmetrically at the downstream end of a cylindrical Pb shield with a proton-recoil detector a few centimeters further down the neutron flight path, along the axis of the shield. The proton-recoil pulses from the detector are analyzed by time-of-flight techniques such that pulse-height information for each time-of-flight channel is preserved. The monitor is useful in the neutron-energy range from a few hundred keV to tens of MeV. (auth)

8778 NEUTRON PARAMAGNETIC SCATTERING WITH A PULSED NEUTRON SOURCE OF AN ELECTRON LINAC. Watanabe, N. (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science); Ishikawa, Y.; Tsuzuki, K. (Tohoku Univ., Sendai (Japan). Dept. of Physics). Nucl. Instrum. Methods; 120: No. 2, 293-300(1 Sep 1974).

A TOF (time-of-flight) type crystal spectrometer to measure the neutron incoherent scattering has been installed at the pulsed neutron source produced by the Tohoku electron linac. The monochromatized pulsed neutron beam has been obtained by Bragg reflection from a large quasi-bent pyrolytic graphite plate and the energy spectrum of the scattered neutrons has been determined by the conventional TOF method. The spectrometer has been used to detect the paramagnetic scattering from the powder specimens of various manganous oxides to determine the nearest-neighbour exchange integrals between Mn^{2+} ions in the oxide. It has been found that several hours operation is sufficient to accumulate the data with reasonable resolution and good signal-to-noise ratio. The spectrometer has also been used to measure the paramagnetic scattering from a single crystal of a Heusler alloy of Pd$_2$MnSn, and the difference in energy spectra between the scattering at the zone boundary and that at the zone center could be detected at a temperature of $T/T_C = 1.5$. (auth)

High Energy Physics Instrumentation

8779 LIQUID-ARGON IONIZATION CHAMBERS AS TOTAL-ABSORPTION DETECTORS. Willis, W. J. (Yale Univ., New Haven, Conn. (USA). Dept. of Physics); Radeka, V. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Instrum. Methods; 120: No. 2, 221-236(1 Sep 1974).

A new detector for the measurement of energy by total absorption, based on the use of multiple-plate ion chambers, is described. The use of liquid argon as the working medium and optimized readout results in an electronic noise contribution to the resolution of less than 0.1 GeV, in a large detector. The use of thin plates, 0.1 radiation length, ensures that sampling fluctuations are small. The technique allows absolute calibration and very good gain stability. Tests on a detector large enough to absorb a high-energy electromagnetic shower are described, where the energy resolution is limited by the residual sampling fluctuations. (auth)

8780 A HODOSCOPE SPECTROMETER FOR INTERMEDIATE AND HIGH ENERGY PHOTONS. Heusch, C. A.; Kline, R. V.; Yellin, S. J. (California Univ., Santa Cruz (USA)). Nucl. Instrum. Methods; 120: No. 2, 237-243(1 Sep 1974).

The design, construction, and testing, and operational experience with a detection device for photons of energies from 150 MeV to 1 GeV is described. The device, which combines Cherenkov radiator and track-chamber elements, attempts to optimize energy resolution and trajectory information for this (difficult) energy interval. Extension to higher energies is straightforward. Performance characteristics are given from calibration runs and from experience during a major experiment involving heavy backgrounds. (auth)

Radiometric Instruments

Refer also to abstract 8796.

8781 (PB-234696) COAL MINE DUST INCOMBUSTIBLES CONTENT ANALYZER USING A GAMMA-RAY BACKSCATTER TECHNIQUE. Report of Investigations. Armstrong, F. E. (Bureau of Mines, Washington, D. C. (USA); Bureau of Mines, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Jul 1974. 15p. (BM-RI-7946). NTIS $3.00.

An instrument using a gamma-ray backscatter technique for determining the weight percent incombustibles content of coal dust and rock dust mixtures in coal mines has been built and tested. The unit gives a direct readout in percent incombustibles for coal-mine dust mixtures containing between 50 and 100% incombustibles; calibration of the device requires using a sample of the rock dust employed; this is usually limestone but occasionally dolomite or gypsum. A small americium-241 source is used with a scintillation detector whose output feeds a ratemeter. The source-detector geometry used was chosen to reduce the effects of variation in bulk density. Accuracy of the system is within plus or minus 3% for most mixtures. The instrument is portable and completely self contained; the rechargeable batteries supply power for 300 to 400 determinations. (GRA)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

8782 (PEM-43) CHARACTERISTICS AND APPLICATIONS OF METAL OXIDE VARISTORS FOR EMP HARDENING. Tesca, D. M.; Peden, J. C.; Beilfuss, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1974. 21p. Dep. NTIS $4.25.

The work being carried out in studying the application of a new class of varistor materials as transient protection devices for EMP environments is summarized. The program consists of two principal tasks. The first was to perform basic material characterization studies of particular importance to EMP hardening. The second task is utilizing the results of these material studies to develop prototype surge suppression cable connectors where the varistor is incorporated as an integral part of connector assemblies. The results discussed are entirely associated with the varistor material type "DD" which is currently manufactured by the General Electric Company under the trade name GE-MOV Varistor. This material type exhibits a nominal clamping voltage level of about 150 volts per millimeter of varistor material between conducting electrodes when operating at a current density level of 1 milliampere/cm^2. Other varistor material types exhibiting higher volts per millimeter ratings were also evaluated, though not to the depth involved with material type "DD," in the present program. (WHK)

8783 EFFECTS OF X-RAY RADIATION TO THE SURFACE-STATE DENSITY IN A METAL–OXIDE–SEMICONDUCTOR STRUCTURE. Ellialtioglu, R. M.; Sencer, O. (Ankara Nuklear Arastirma Merkezi (Turkey)). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 1, 23-25(Feb 1974).

A 2160 Å thick SiO_2 layer was grown on a p-type silicon wafer of resistivity 5 ohm-cm and an Au–SiO_2–Si–Al MOS structure was built. The C–V characteristics of the structure were measured at 4.5 MHz, and the surface-state density was calculated to be about 1.4×10^{11} cm^{-2}. Change in the surface-state density with x-ray irradiation was investigated. (INIS)

8784 INFLUENCE OF NEUTRON IRRADIATION UPON THE CHARACTERISTICS OF FULLY DEPLETED SILICON SURFACE BARRIER DETECTORS. Kaganskaya, M. E.; Fedoseeva, O. P.; Sinitsyn, B. I. Sov. At. Energy (Engl. Transl.); 36: No. 4, 399-401(Apr 1974).

Translated from At. Energ. (USSR); 36: No. 4, 317-318(Apr 1974).

Industrially produced fully depleted (dE/dx) silicon surface barrier detectors were irradiated with neutron fluxes of 10^{10} to 10^{13} n/cm^2. The signal amplitude, energy resolution for α particles (^{241}Am), capacity of the p-n junction, and inverse currents were measured before and after irradiation. Results are presented and discussed. (WHK)

Miscellaneous Instruments

Refer also to abstracts 8735, 10250, 10253, and 10267.

8785 A MINIATURE EXTRACTOR GAUGE FOR THE UHV. Blechschmidt, D. (European Organization for Nuclear Research (CERN), 1211 Geneva 23, Switzerland). J. Vac. Sci. Technol. 11: No. 6, 1160-1165 (Nov 1974).

The design and performance of a miniaturized hot filament ionization pressure gauge, specially developed for the CERN intersecting storage rings, is described. It is mounted on a standard metal flange with ceramic feedthroughs and fits into an aperture of 15.7 mm. The gauge is of the extractor type and has a sensitivity factor for nitrogen of about 5 Torr^{-1}. Its low pressure limit, about 5×10^{-12} Torr nitrogen equivalent, is mainly due to x rays. These two characteristic figures have been obtained, in spite of the gauge's smallness, by an optimization of most of the geometrical and electronical parameters. Some problems, seriously affecting the gauge's performance, and particularly arising from its size, such as space charge effects and thermal outgassing, are discussed. (auth)

8786 LIQUID IONOGRAPHY FOR DIAGNOSTIC RADIOLOGY. Fenster, A.; Johns, H.E. (Department of Medical Biophysics, University of Toronto and The Ontario Cancer Institute, 500 Sherbourne Str., Toronto, Ontario, Canada). Med. Phys. 1: No. 5, 262-265 (Sept 1974).

In liquid ionography the x–ray photons are absorbed in a liquid containing a high–atomic–number atom, such as tetra–methyl–tin. The liquid is contained between two parallel electrodes separated by a few millimeters. Most of the ions produced in the liquid recombine. Those that escape recombination are collected on an insulating foil covering one of the electrodes. The resulting charge pattern is rendered visible using powder–cloud development. For a 4–mm electrode separation and using 45–kVp x rays, about 98% of the radiation is absorbed; for 105–kVp x rays, about 88% of the radiation is absorbed. We studied the sensitivity of a 4–mm chamber as a function of the applied electric field and found that, for 65–kVp x rays and an electric field of 70 kV/cm, the sensitivity is 1 nC/cm^2–mR. We present an image of a test pattern with a resolution of better than 10 lp/mm produced by this system. (auth)

8787 USE OF X-RAY-RADIOMETRIC ANALYZER FOR ANALYZING THE SAMPLES FROM THE KHIBINY APATITE DEPOSITS. Ashitok, V. I.; Baldin, S. A.; Bol'shakov, A. Yu.; Migulya, V. A. (Soyuznyj Nauchno-Issledovatel'skij Inst. Priborostroeniya, Moscow (USSR)). pp 40-45 of Manufacture of Nuclear Instruments. Moscow; Atomizdat (1973). (In Russian).

3 refs.; 2 figs.

The circuits and construction of the x-ray radiometric analyzer of the FAMZ-01 type are examined. The results of its use during P sampling in naturally occurring deposits with use of the correlation dependence of the P content on the rare earth content are described. (tr-auth)

8788 HIGH RESOLUTION ION CYCLOTRON RESONANCE SPECTROSCOPY. McIver, R. T. Jr.; Baranyi, A. D. (California Univ., Irvine (USA). Dept. of Chemistry). J. Mass Spectrom. Ion Phys.; 14: No. 4, 449-458(Aug 1974).

Methods are described for greatly improving the mass resolution of an ion cyclotron resonance mass spectrometer. The factors affecting mass resolution are examined in detail, and the conditions for maximum resolution are discussed. Only three parameters—magnetic field strength, cyclotron frequency, and analyzer cell trapping voltage—are needed to make accurate, absolute mass measurements. Ions are detected with a solid-state marginal oscillator circuit which has been designed to be stable at very low r.f. levels. (auth)

8789 THE SEPARATION POWER OF WIEN FILTERS. Gelfort, E. J. Mass Spectrom. Ion Phys.; 14: No. 4, 349-361(Aug 1974). (In German).

A survey of the different applications of the Wien filter (crossed-field velocity analyser) is presented. The focusing properties, the mass dispersion and resolving power and the aperture error of the Wien filter with homogeneous electrostatic and magnetic deflection fields of paraxial beam are calculated. Particles entering the electric field of the Wien filter are accelerated or decelerated according to their off-axis distance, such that this change in energy limits the resolving power of the Wien filter with homogeneous fields. Calculations show that it is possible to compensate this change in velocity. A new type of Wien filter is discussed, capable of substantial beam separation by replacing the homogeneous magnetic field by a nonhomogeneous field, with changing strength due to the tapering of the pole-shoes. (auth)

8790 A VELOCITY FILTER FOR THE ANALYSIS OF HEAVY ION REACTION PRODUCTS. Muenzenberg, G. (Giessen Univ. (F. R. Germany). 2. Physikalisches Inst.). J. Mass Spectrom. Ion Phys.; 14: No. 4, 363-387(Aug 1974). (In German).

If thin targets are bombarded with heavy ions of a few MeV/nucleon recoiling ions are produced. These can be separated from the primary particles by a velocity filter. A two-state velocity filter for this purpose is discussed. (auth)

8791 THE OPTIMIZATION OF ELECTROSTATIC ENERGY SELECTION SYSTEMS FOR LOW ENERGY ELECTRONS. Read, F. H.; Comer, J.; Imhof, R. E.; Brunt, J. N. H.; Harting, E. (Manchester Univ. (UK). Dept. of Physics). J. Electron Spectros. Relat. Phenomena; 4: No. 4, 292-312(Oct 1974).

Design criteria are presented which allow electrostatic energy selection systems to be optimized to give the highest currents for electron beams having a low mean energy ($\lesssim$500 eV) and a small energy spread ($\lesssim$30 MeV). Limitations in various parts of the system are discussed and a relationship between the current delivered by the system and the energy spread is presented. Different types and sizes for the energy selectors in these systems are considered and the best results are obtained with hemispherical deflectors. The advantage of using, within reasonable limits, a large selector with small image sizes is also demonstrated. (auth)

8792 A HIGH-EFFICIENCY NEUTRON SPIN-FLIPPER FOR TIME-OF-FLIGHT APPLICATIONS. Badurek, G.; Westphal,

G. P.; Ziegler, P. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Nucl. Instrum. Methods; 120: No. 2, 351-352(1 Sep 1974).

Performance of a Mezei-type neutron spin-flipper is described, which is well suited for chopper applications because of its extremely low coil inductivity. (auth)

8793 NEUTRON MIRROR MONOCHROMATIZING SYSTEMS (NMMS) INCORPORATING BENT MIRRORS. Fiala, W.; Perez Arenas, C. (Puerto Rico Univ., Mayaguez). Nucl. Instrum; Methods; 120: No. 2, 211-220(1 Sep 1974).

The performance of bent neutron monochromatizing mirror systems is presented. The study includes a discussion of different systems incorporating mirrors the shape of which is a circle, a parabola or a logarithmic spiral. Optimum parameter configurations for intensity and for resolution are given. Such systems, in the proper state of development, appear to outperform by far other known methods of cold neutron monochromatization. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

8794 TECHNOLOGY ASSESSMENT OF URANIUM ENRICHMENT BY CENTRIFUGE METHOD. Kanagawa, A. (Nagoya Univ., Japan). Genshiryoku Kogyo; 20: No. 2, 40-45(Feb 1974). (In Japanese).

Japan is being pressed by the necessity to make a decision regarding the supply of enriched uranium to meet its rapidly increasing demands. Various enriching plants are dynamically competing with their economical superiority or possibility in the world. Since 1973, the development of the gas centrifuge method as a national project has been initiated on the basis of the independent technology in Japan. However, its achievement must be seriously evaluated in competition with the gas diffusion technology in U.S. and the gas centrifuge technology being co-developed by the UK, the Netherlands, and West Germany. The features of the centrifugal gas separation plant are, first its high energy efficiency, and second, requirement of many unit machines. The gas centrifuge method has a larger separation factor than the gas diffusion method and is a balanced separation process. Also, the construction of rotary cylinders and the mechanisms for gas injection and extraction, gas counter flow, bearings, gas seals, and driving of the gas centrifuge are described. At present, data for the verification of each component are insufficient, therefore, future research and development are anticipated. (JA)

8795 METHOD OF ELECTROMAGNETIC SEPARATION OF RADIOACTIVE ISOTOPES OF RARE-EARTH ELEMENTS DIRECTLY FROM TARGETS. Latuszynski, A.; Zuber, K.; Zuber, J.; Potempa, A.; Zuk, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). Nucl. Instrum. Methods; 120: No. 2, 321-328(1 Sep 1974).

A method of fast extraction of isobars of rare-earth elements by direct separation from the proton-irradiated targets without chemical processing has been developed. The efficiency of the diffusion process of separate rare-earth elements from a tantalum target depending on temperature and duration of the process has been measured. The conditions securing a high degree of diffusion during a 2 to 3 min period have been found and the possibility of utilization of the diffusion process for the electromagnetic separation of rare-earth elements according to isobars has been proved. The efficiency of the separation process using the ion sources with surface ionization has been measured under different working conditions. Using the method proposed for investigations in the field of nuclear spectroscopy the gamma spectra of short-living isotopes with $T_{1/2} \geq 1$ min have been measured. The new isotopes ^{161}Yb(4.2 min), ^{148}Dy(3.5 min) and ^{132}Pr(1.6 min) have been identified. The possibility of effective application of this method to spectroscopic investigations of many elements has been proved. (auth)

Radiation Sources

Industrial Uses

Refer also to abstracts 8288 and 8746.

8796 POSITRON THICKNESS MONITORING. Vorob'ev, A. A.; Kuz'minykh, V. A.; Vorob'ev, S. A.; Tsekhanovskii, I. A.; Timoshnikov, Yu. A. (Tomsk Polytechnic Inst., USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 1, 94-96(1974).

Translated from Defektoskopiya; 10: No. 1, 116-118(1974).

Radioactive electron sources used for measuring and monitoring coatings by backscattering or transmission; beta-ray backscattering require strong sources and cannot be used with large thicknesses on account of onset of saturation. Transmission does not provide high accuracy for large thicknesses on account of the considerable intensity reduction near the maximum range. It is, therefore, of interest to measure the beta-ray flux absorbed in the material, but this is difficult to do for electrons. It is shown that one can monitor the thickness of a material by absorption if a positron radioactive source is used. (auth)

8797 VNII INSTALLATIONS FOR IRRADIATION TREATMENT OF AGRICULTURAL PRODUCTS. Savitskij, V. S.; Leshchinskij, N. I.; Bukhteev, V. V.; Osipov, V. B. pp 108-111 of Isotope and Nuclear Radiation Application in Agriculture. Section 1. Agricultural Radiobiology. Moscow; Atomizdat (1971). (In Russian).

From All-Union scientific-technical conference "20 years of production and isotope and nuclear radiation application in national economy of the USSR"; Minsk, USSR (7 Oct 1968).

An installation for the irradiation of agricultural materials was designed and fabricated. Studies on the use of irradiation basically followed two directions: presowing irradiation of seeds or tubers and the irradiation of vegetables subject to prolonged storage in order to increase the preservation time of the products in a standardized state. A description is given of some radiation installations designed for the agricultural industry. (tr-auth)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 8262, 8263, 8280, and 10464.

8798 (UCLA–12-966, pp 1-13) BIOCHEMISTRY RESEARCH. 1974.

In annual progress report for the period ending June 30, 1974.

The division of biochemistry reports progress in the following areas of research: lipid metabolism in brain and membranes in development and aging; autoxidative degeneration of membranes; desaturation and hydroxylation of fatty acids; lipid composition, function, and metabolism in marine organisms; and radiation chemistry of lipids. (ERB)

8799 (UCLA–12-966, pp 141-153) RADIOBIOLOGY RESEARCH. 1974.

In annual progress report for the period ending June 30, 1974.

Progress is reported in the following fields of research: radiation chemistry of nucleic acid constituents; radiation biochemistry of nucleic acids and their constituents; radiation biochemistry of proteins and amino acids; cellular and mammalian studies in radiation biology. (HLW)

8800 (USC-113P21X8) ESR STUDIES OF THIYL FREE RADICALS IN RELATION TO BIOLOGICAL EFFECTS OF RADIATIONS. Progress Report. Wolf, W. (University of Southern California, Los Angeles (USA)). 1 Aug 1974. Contract AT(04-3)-113. 44p. Dep. NTIS $5.25.

Progress is reported on the following research projects: kinetic studies; influence of added KCl and $CeCl_3$ on the C/RS ratio; effects of added salts and temperature on penicillamine signals; hindered internal rotation in the glutathione thiyl free radical; influence of various substituents of the radioprotective aminothiols on thiyl free radical ESR spectra; protein modifications to allow observation of thiyl free radical ESR signals from biomacromolecules; and influence of ionic strength on RS spin concentrations at varied pH. The following appendices are included: ESR studies of free radicals in solution; computer programs for ESR spectral analysis; and operational characteristics of a stopped-flow system for ESR studies. (HLW)

8801 STUDIES ON IRRADIATION OF AGAR–AGAR IN THE SOLID STATE. On the Changes of Infrared Spectra of Agar–Agar Film Produced by Irradiation. Nisizawa, M. (Defense Academy, Yokosuka, Japan). Radiat. Eff.; 22: No. 3, 187-189(1974).

The effects of radiation on the radicals of agar–agar molecule were studied by measuring the infrared spectra at different radiation doses and times after irradiation. The experimental equations for the infrared spectra were given by (a) $A = a(\log X)^2 + b \log X + c$; and (b) $A = b - a \log t$; where A is the absorbance ratio of radical stretching vibration of the agar–agar film, X is the radiation dose, t is the elapsed time after irradiation, and a, b, and c are adjustable constants. (auth)

8802 THE ACTION OF IONIZING RADIATION ON THE HISTONE COMPONENT OF DNP. Rzendowska, F. (Panstwowy Zaklad Higieny, Warsaw (Poland)). Rocz. Panstw. Zakl. Hig.; 23: 621-627(1972). (In Polish).

Aqueous fraction of DNP derived from calf thymus was irradiated in vitro with doses from 8000 to 24,000 R. It was demonstrated that the dose of 10,000 R and higher doses cause disappearance of one of five electrophoretic histone fractions which is rich in arginine. The number of thiol groups was determined in DNP-derived histones following radiation exposure to a dose of 10,000 R or higher and it was shown that their number decreases by 70% as related to control determinations. (auth)

8803 EFFECT OF IONIZING RADIATION ON THE RATE OF THE RANDOM COIL TO DOUBLE HELIX CONFORMATION CHANGE OF POLY d(A–T). Stephens, J. Newark, DE; Univ. of Delaware (1974). 99p. University Microfilms Order No. 74-26,146.

Thesis (Ph. D.).

Ionizing radiation was observed to significantly decrease the rate of the random coil to double helix renaturation process in the polynucleotide poly d(A–T). The results indicate that less than 5 krads of radiation induced a 3-fold decrease in the rate of the fastest of three first-order renaturation processes. This fast process has been reported to involve the twisting of a single poly d(A–T) chain into a double stranded structure. Moreover, the extent of the fastest process was reduced by 60 to 70% with a radiation dose of less than 5 krads. The extent of the total renaturation process, however, was observed to be the same with or without exposure to irradiation. Therefore slower processes have become significantly more important in the total renaturation process as a result of irradiation. This radiation-induced kinetic effect is observed to be most significant at low "biologically lethal" doses (~1 krad). Sedimentation and absorbance studies were also undertaken to observe the effect of ionizing radiation on the molecular weight and the base chromophores of poly d(A–T). The results indicate that approximately two single strand breaks were produced in a single poly d(A–T) chain for every 5 krads of radiation exposure. It is concluded from these and other considerations that the very sensitive radiation-induced kinetic effects noted above probably do not result from strand scissions. Preliminary results from absorbance studies suggest that base chromophore damage may not necessarily be a directly related significant factor in these low dose kinetic effects. Thus, deoxyribose and/or non-chromophoric base damage are the most likely causes of the observed kinetic effects. (Diss. Abstr. Int., B)

8804 ADENOSINE TRIPHOSPHATE PRODUCTION OF MITOCHONDRIA DURING AND AFTER X IRRADIATION. Pettengill, H. J. Ann Arbor, MI; Univ. of Michigan (1974). 104p. University Microfilms Order No. 74-25,293.

Thesis (Ph. D.).

A method for monitoring ATP production of a mitochondrial suspension during and after irradiation is described. Purposes of this study were not only to establish whether immediate and transient effects occur, but also whether there were any differences in the radiosensitivity of mitochondria isolated from different tissues, and finally to determine what effects various mitochondrial dilution media had on any radiation response. Two systems were used to monitor ATP production. A photomultiplier tube was used to record the luminescence produced by a firefly luciferase reaction, of which ATP is the substrate. An oxygen probe measured the oxygen concentration in mitochondrial suspensions. Both systems are either direct or indirect indicators of ATP production. The photometers are described. One photometer was used to assess the optimal physical, chemical and kinetic characteristics of the luciferase reaction. The other photometer enabled the generation of steady-state concentrations of ATP in its reaction vessel during an experimental sequence. This photometer was coupled to an x-ray generator and any observed changes in steady-state luminescence or oxygen concentration produced by irradiation indicated a change in ATP production by the mitochondrion. On the basis of this study, it was concluded that the rate of ATP production by mitochondria is not affected by doses less than 8500 rads. No radiosensitivity differences were observed in mitochondria isolated from different tissue or prepared in varied dilution media. Also, the respiratory state of the mitochondrion during irradiation did not affect its sensitivity to irradiation. Therefore, the hypothesis that oxidative phosphorylation of the mitochondrion is a site of primary radiation damage was rejected. (Diss. Abstr. Int., B)

8805 INACTIVATION OF RIBONUCLEASE S-PEPTIDE BY THE PRIMARY AQUEOUS RADICALS. Mee, L. K.; Adelstein, S. J. (Harvard Medical School and Shields Warren Radiation Lab., Boston). Radiat. Res.; 60: No. 3, 422-431(Dec 1974).

The separate contributions of the primary radical species to changes in enzymatic activity, amino acid composition, and molecular configuration of RNase S-peptide were determined by γ-irradiation of dilute solutions in controlled environments. For H· and ·OH, approximately one out of two radicals is effective for the enzymatic inactivation of S-peptide; e^-_{aq} is much less effective, only one out of eight or more radicals causing loss of activity. Amino acid analyses of irradiated S-peptide show that only the single sulfur-containing residue, methionine, and the single aromatic residue, phenylalanine, are significantly destroyed. For H atom attack, loss of enzymatic activity correlates with the destruction of methionine; phenylalanine is much less affected and no new products are separated on gel filtration. Hydroxyl radicals cause a significant destruction of phenylalanine, as well as methionine, and gel filtration shows that a new product of higher molecular weight is formed. (auth)

8806 CONTRIBUTION OF VARIOUS TYPES OF DAMAGE TO INACTIVATION OF BACTERIOPHAGE PM2 DNA IN FROZEN SOLUTION BY GAMMA-RADIATION. van der Schans, G. P.; Bleichrodt, J. F. (Rijksverdedigingsorganisatie TNO, Rijswyk, Netherlands). Int. J. Radiat. Biol.; 26: No. 2, 121-126(Aug 1974).

When biologically-active double-stranded circular DNA of the bacteriophage PM2 in a solution of nutrient broth was irradiated at –196°C by ^{60}Co gamma rays, about 85% of the inactivation was due to nucleotide damage, i.e. damage in the nucleotides not associated with a chain break. Double-strand breaks contributed some 10% to lethality and single-strand breaks only a minor fraction, if at all. About 10% of the nucleotide damage that was lethal if present in single-stranded DNA was lethal in the double-stranded PM2 DNA. These results did not show large differences from those obtained previously for irradiation of PM2 DNA under conditions of indirect effect. (auth)

8807 KINETIC STUDIES OF THE EFFECT OF RESTORATION OF A REQUIRED AMINO ACID ON POST-IRRADIATION DNA DEGRADATION AND CELL PERMEABILITY. Pollard, E. C.; Billen, D.; Achey, P. M. (Pennsylvania State Univ., University Park). Int. J. Radiat. Biol.; 26: No. 2, 107-119(Aug 1974).

The kinetics of formation of the inducible inhibitor of post-irradiation DNA degradation were studied by amino-acid deprivation in four Escherichia coli strains: 15T-(555-7), B/r59, WP2, and B_{s-1}32. In the first three, the inducible inhibitor was absent if the required amino acid was withheld and DNA degradation following gamma radiation was considerable. After restoration of the amino acid, the inhibitor appeared in 7 min and was at 50% maximum in 14 min. In B_{s-1}32 there was no effect of withholding the amino acid. Strain 555-7 also exhibited cell leakage, probably due to the induction of a defective prophage. This leakiness appeared at 14 min with a 50% maximum at 22 min. Strains WP2 and B/r59 had very little post-irradiation leakiness yet showed strong induced inhibition. The data suggested that there was no necessary connection between the inducible inhibitor and a prophage. Preliminary U.V. induction in WP2 produced nearly complete inhibition, yet conferred very little survival potential. (auth)

8808 SYNTHESIS OF DNA BY MEMBRANE-DNA COMPLEXES FROM E. COLI B/r AND E. COLI B_{s-1} AFTER EXPOSURE TO UV LIGHT. A Comparison With the Effects of Ionizing Radiation. Cramp, W. A.; Petrusek, R. (Hammersmith Hospital, London). Int. J. Radiat. Biol.; 26: No. 3, 277-284 (Sep 1974).

The DNA-synthetic activity of membrane-DNA complexes isolated either from uv-irradiated E. coli B/r or E. coli B_{s-1} was reduced to nearly the same extent by the same dose. This result was similar to that observed in earlier work when irradiation was with 7-MeV electrons. However, quite unlike ionizing radiation the activities of the membrane-DNA complexes were depressed by uv to the full extent when isolated immediately after irradiation. Also uv light did not inhibit DNA synthesis at high doses to a lesser extent than at low doses as does ionizing radiation. Long exposure times failed to reduce the DNA synthetic ability of the membrane complex much below 50% of the unirradiated control. These results show that uv inhibits DNA synthesis by membrane complex in this system in a very different way from ionizing radiation and since uv specifically causes structural changes in DNA it is suggested that ionizing radiation reduces the synthetic activity of the membrane-DNA complexes via structural deformation of other macromolecules. (auth)

Radiation Effects on Cells

Refer also to abstracts 8799, 8887, and 8903.

8809 (COO-1671-58) INITIAL SLOPE OF THE GAMMA-RAY SURVIVAL CURVE IN THE THEORY OF RBE. Katz, R.; Sharma, S. C. (Nebraska Univ., Lincoln (USA)). 1974. 16p. (CONF-740960-2). Dep. NTIS $4.00.

From 6th L. H. Gray conference on initial shapes of cell survival curves; clinical and theoretical implications; London, UK (16 Sep 1974).

Inferences about the initial slope of survival curves of cells exposed to γ rays may be drawn from the variations of RBE with dose and with radiation quality. As perceived by a biological cell, capable of accumulating sub-lethal damage, the essential difference between a primary photon and a primary heavy particle lies in the probability that a single particle can eject sufficient delta rays to inactivate the cell through which it passes. If, in track segment irradiation with monoenergetic ions, we segregate the fraction of segments "hit" by the ion (ion-kill), the remaining fraction inactivates by the same physical mechanism (the tangle of electron tracks from different primaries) as gamma-ray photons (gamma-kill). The survival curve from gamma-kill alone can be taken to be identical with that from gamma-rays, to a sufficient approximation. It is only from the contribution of the ion-kill mode that the RBE can exceed 1 at any LET. The effects of cell population heterogeneity and LET on the survival curve is discussed. The RBE-dose relations for neutrons in the energy range 0.43 to 14 MeV were also calculated for leukemia induction and lens opacification in the mouse and for survival of cultured mouse bone marrow cells, kidney cells, HeLa cells, and hamster cells. (CH)

8810 (COO-1671-59) RBE-DOSE RELATIONS FOR NEUTRONS AND PIONS. Katz, R.; Sharma, S. C. (Nebraska Univ., Lincoln (USA)). 1974. 20p. (CONF-740940-3). Dep. NTIS $4.00.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, F. R. Germany (30 Sep 1974).

From cellular radiosensitivity parameters and theoretical particle energy spectra for neutrons and pions, calculations of the RBE of neutrons (contaminated with x-rays) and of pion-stars (admixed with a low LET dose from the stopping power of light particles) are made, as experienced by a variety of mammalian cells. The calculated results are compared to data obtained with 14 MeV neutrons admixed with gamma-rays, as experienced with CHO cells, and with clinical values of RBE-dose relations for neutrons of different energies in relation to lens opacification in the mouse, and effects observed in skin, haemopoietic tissue, growing cartilage and intestine. Calculated curves for aerobically irradiated cells are consistent with observations for normal tissues (below neutron doses of 500 rads/fraction). Calculated curves for anoxically irradiated cells are consistent with observations for tumors. Where the heavy particle-energy spectrum is known, the dosimetric problem may be reduced to the determination of the high and low LET doses. A prediction of RBE at the measured dose may be made from the appropriate irradiation equivalent of the field. (auth)

8811 (UCLA-12-966) ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1974. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1974. Contract AT(04-1)-GEN-12. 177p. Dep. NTIS $7.60.

Separate abstracts were prepared for the six sections of the report. A list of 157 publications and reports for the period July 1, 1973, through June 30, 1974, is appended. (HLW)

For abstracts of individual sections see: 8798, 8799, 8878, 8912, 8976, and 8992.

8812 (UCLA-12-966, pp 15-31) DEVELOPMENTAL BIOLOGY RESEARCH. 1974.

In annual progress report for the period ending June 30, 1974.

The division of developmental biology reports progress in the following areas of research: effects of hormones on cell function and enzyme inductions; organ specific proteins and cell structures; and control of growth and development of cells in culture. (ERB)

8813 (UCSF-10P2-243) MEASUREMENT OF VERY LOW OXYGEN TENSIONS IN LIQUIDS: DOES THE EXTRAPOLATION NUMBER FOR MAMMALIAN SURVIVAL CURVES DECREASE AFTER X-IRRADIATION UNDER ANOXIC CONDITIONS? Koch, C. J. (California Univ., San Francisco (USA). Lab. of Radiobiology). 1974. 16p. (CONF-740960-3). Dep. NTIS $4.00.

From 6th L. H. Gray conference on initial shapes of cell survival curves; clinical and theoretical implications; London, UK (16 Sep 1974).

Measurements of very low partial pressures of oxygen show that a vacuum degassing system combined with an oxygen consuming agent (sodium dithionate) and/or radiochemical oxygen consumption removes all of the oxygen from cultured animal cells plated on glass dishes. When these cells are x-irradiated, the extrapolation number remains the same under both aerobic and anoxic conditions, and an oxygen enhancement ratio of 3.0 is observed. Several other physical and chemical factors tested also have no effect on the extrapolation number. (auth)

8814 MAGNITUDE OF MITOTIC INHIBITION IN RELATIONSHIP TO SINGLE AND SPACED DOSES OF X IRRADIATION. Siracka, E. (Cancer Research Inst., Bratislava). Neoplasma; 21: No. 5, 519-523(1974).

The magnitude of mitotic inhibition and the recovery phase were studied in HeLa cells after the application of single, split, and repeated exposure to x irradiation, in the range of 25 to 500 R. Second exposure was applied at time of mitotic depression (3 hrs following the first exposure). Repeated dose of irradiation (up to 200 R) resulted in dose-dependent prolongation of mitotic delay with increased rate of partial synchronization. Between spaced doses of irradiation in low sublethal range, partial recovery took place at time elapsing between the first and second dose of irradiation; on the other hand with increase in dose, no recovery was observable during this time. (auth)

8815 EFFECT OF X-RAYS ON THE PHOSPHORYLATION ON HISTONE f_1 IN THYMOCYTES. Dancheva, K.; Nikolova, R. (Vissh Meditsinski Inst., Sofia (Bulgaria)). Suvrem. Med.; 24: No. 2, 15-19(1973). (In Bulgarian).

X-rays applied in vitro in a dose of 100 R inhibit phosphorylation of histone f_1 isolated after incubation of thymocyte suspension. This is established by the quantity of the phosphates in histone f_1 and by the incorporation of ^{32}P in it. In the first 10 minutes dithiotreitol increases phosphorylation of histone f_1 in intact thymocytes followed by a considerable inhibition. In the irradiated thymocytes dithiotreitol exerts a protective effect by phosphorylation of histone f_1. The protector increases the O_2 consumption which is possibly due to the affection of respiration by phosphorylation. (auth)

8816 EFFECT OF X-RAYS ON NUCLEAR AND CYTOPLASMIC PROTEIN SYNTHESIS IN L5171Y-S CELLS: DIFFERENTIAL INHIBITION. Szumiel, I.; Rosiek, O.; Budzicka, E. (Institute of Nuclear Research, Warsaw (Poland)). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 20: 571-575(1972).

Irradiation of murine leukaemic lymphoblasts L5178Y-S with 400 rads of x rays reduces incorporation of ^{3}H-thymidine into DNA to about 80% of the control level. To examine the effect of the same dose of x rays on protein synthesis, incorporation was determined of radioactive amino acids into the 4 following protein fractions: lysine-rich histone Fl, remaining histone, acid-insoluble nuclear proteins, and cytoplasmic proteins. Radioinduced reduction of the specific activity was most pronounced in histone Fl and the remaining histones (about 30%). Synthesis of acid insoluble nuclear proteins was less inhibited (about 9% decrease) while only a small change (about 3%) was observed for the cytoplasmic proteins. (auth)

8817 RBE AND OER VARIATIONS OF MIXTURES OF PLUTONIUM ALPHA PARTICLES AND X-RAYS FOR DAMAGE TO HUMAN KIDNEY CELLS (T-1). Raju, M. R.; Jett, J. H. (Los Alamos Scientific Lab., NM). Radiat. Res.; 60: No. 3, 473-481(Dec 1974).

Cell survival measurements using T-1 cells were made following exposure to several mixtures of high LET alpha particles from ^{238}Pu with x rays under aerobic and hypoxic conditions. The results indicate that a small percentage of the total dose due to alpha particles was very effective in reducing the OER; however, the RBE does not increase appreciably. For example, when only 11% of the total dose was due to alpha particles, the OER was 1.8 compared to 2.5 for x rays, although the RBE was less than 1.2. These results are consistent with published results of OER and RBE measurements using fast neutrons and the broadened Bragg peak of a helium ion beam. (auth)

8818 CHROMOSOME ABERRATIONS AND T-CELL SURVIVAL IN HUMAN LYMPHOCYTES. Mello, R. S.; Kwan, D.; Norman, A. (Univ. of California, Los Angeles). Radiat. Res.; 60: No. 3, 482-488(Dec 1974).

The average number of chromosome aberrations per cell decreases by 40 and 50%, respectively, when human peripheral blood lymphocytes are cultured for 3 and 5 days after exposure to 400 rads of gamma rays and before stimulation with phytohemagglutinin (PHA). The decrease is due primarily to a loss of cells with multiple aberrations. The results are consistent with the hypothesis that a chromosomal radiosensitive subpopulation of PHA-responsive cells is eliminated preferentially by radiation. Examination of the survival of T-cells, which are PHA-responding cells, 4 days after exposure to graded doses of gamma rays suggests the presence of two subpopulations differing in radiosensitivity, in support of the hypothesis. Also in support are the results of chronic radiation studies which show that the yield of aberrations is independent of dose rate over the range of 11 to 59 rads/hr, if the dose is delivered in 24 hr or less, a time when cell loss is small. The decrease in aberration yield that has been observed when the irradiation is extended over 3 days is probably then the result of selection against radiosensitive cells. (auth)

8819 COMPARISON OF THE EFFECTIVENESS OF NF-167 AND METRONIDAZOLE AS HYPOXIC CELL SENSITIZERS OF KHT TUMOR CELLS IN VITRO. Thomson, J. E.; Rauth, A. M. (Univ. of Toronto). Radiat. Res.; 60: No. 3, 489-500(Dec 1974).

Two compounds, NF-167 (5-nitro-2-furaldehyde-5-[3-diethylaminopropyl] semioxamazone hydrochloride) and metronidazole (2-methyl-5-nitroimidazole-1-ethanol), were selected for in vitro testing of their abilities to sensitize hypoxic KHT tumor cells to ionizing radiation. Metronidazole had been shown previously to sensitize hypoxic KHT cells in mice while NF-167 had shown no in vivo sensitization. The acute and chronic toxicities of the drugs were determined and then sensitization was measured after a single dose of radiation as a function of drug concentration. Survival curves were determined at a cell concentration of 5 × 10^5 cells/ml using 27 μM NF-167 and 5.8 and 29 mM metronidazole. The enhancement ratio of NF-167 was found to be 1.5, and that of metronidazole was 1.4. The effect of cell density on the sensitizing abilities of these compounds was investigated and it was found that at densities near 10^8 cells/ml NF-167 lost the ability to sensitize hypoxic cells, while metronidazole showed little loss of sensitizing ability. Supernatant taken from the high cell density NF-167 experiment still contained appreciable levels of drug as measured by colorimetric assay and when KHT cells were resuspended in the supernatant at low cell density, hypoxic cell radiosensitization was again observed. Although the reasons for the cell density effect are not known, these results correlate well with the fact that NF-167 does not sensitize hypoxic KHT cells in vivo while metronidazole does. (auth)

8820 CHANGES IN ELECTROPHORETIC MOBILITY OF CULTURED CELLS AFTER X IRRADIATION AND THEIR MODIFICATION BY SH-BLOCKING AGENTS AND HEMAGGLUTININ. Sato, C.; Kojima, K. (Aichi Cancer Center Research Inst., Nagoya, Japan). Radiat. Res.; 60: No. 3, 506-515 (Dec 1974).

The mechanism of decrease in cell electrophoretic mobility after x-irradiation was tentatively envisaged as change of cell surface conformation, based upon the following results: Electrophoretic mobility was mainly dependent on the negative charge of sialic acid, chondroitin sulfates, and hyaluronic acid of the cell surface. Radioactive labels incorporated into these acidic sugars were not affected by x-irradiation at the time when the electrophoretic mobility showed minimum value. Sulfhydryl-blocking agents (p-chloromercuribenzoic acid, N-ethylmaleimide and iodoacetamide) at concentrations of 1 × 10^{-8} ~ 10^{-6} M completely prevented the reduction in electrophoretic mobility after irradiation. Addition of phytohemagglutinin-M or Concanavalin A to cell cultures before or after irradiation also stopped the decrease in mobility. The rates of decrease and recovery in electrophoretic mobility of x-irradiated cells were not substantially affected by a 9°C temperature reduction. Ultraviolet irradiation did not result in a change in negative charge of the cell surface. (auth)

8821 SYMPTOMS OF X-RAY DAMAGE TO RADIOSENSITIVE MOUSE LEUKEMIC CELLS: ASYNCHRONOUS POPULATIONS. Ehmann, U. K.; Nagasawa, H.; Petersen, D. F.; Lett, J. T. (Colorado State Univ., Ft. Collins). Radiat. Res.; 60: No. 3, 453-472(Dec 1974).

The extreme x-ray sensitivity of the L5178Y S/S cell line is described in terms of cytological symptoms associated with its radiation-induced death. As such, this study forms part of a continuing series of experiments attempting to understand the radiosensitivity of the murine leukemic lymphoblast line. Symptoms of x-ray damage occurred in far more exaggerated forms than those displayed by other mammalian cell types, including a long mitotic delay of approximately 10 hr after a dose of 100 rads and a very high incidence of multipolar postirradiation divisions. Fluorometric profiles indicate that the cells spend the long delay in the G_2 + M phase of the cell cycle. Cellular protein contents and volumes continue to increase during that time. The low survival of L5178Y S/S cells after irradiation may be related more to faulty cytokineses than to chromosomal aberrations per se. (auth)

8822 CALCULATIONS RELATED TO THE POSSIBLE USE OF PHOTONS, NEUTRONS, NEGATIVELY CHARGED PIONS, PROTONS, AND ALPHA PARTICLES IN RADIOTHERAPY. Alsmiller, R. G. Jr.; Santoro, R. T.; Armstrong, T. W.; Barish, J.; Chandler, K. C.; Chapman, G. T. (Oak Ridge National Lab., TN). Radiat. Res.; 60: No. 3, 369-387(Dec 1974).

Calculated results are presented for absorbed dose, LET spectrum, and cell-survival probability as a function of position when photons, neutrons, negatively charged pions, protons, and alpha particles are incident on a tissue phantom. The beam parameters for each type of incident particle were chosen to be approximately those appropriate to the single-port irradiation of a small cylindrical volume (1 cm in radius and 2 cm in height) centered about a depth of 15 cm in the 30-cm-thick tissue slab. Both monoenergetic (15 MeV) neutrons and neutrons produced by 35-MeV ^{2}H on Be are considered. The cell-survival-probability calculations are carried out using the model developed by R. Katz et al., and results are presented for both aerobic and anoxic T-1 kidney cells. Spatially dependent OER's and RBE's for each type of particle considered are also given. (auth)

8823 CELLULAR SURVIVAL IN A MIXED RADIATION ENVIRONMENT. Katz, R.; Sharma, S. C. (Univ. of Nebraska, Lincoln). Int. J. Radiat. Biol.; 26: No. 2, 143-146(Aug 1974).

Calculations of the survival, RBE and OER of human kidney cells, after sequential irradiation with gamma-rays and 14 MeV neutrons, agreed well with the experiments of Railton et al., (1974, Int. J. Radiat. Biol., 25: 121) with CHO cells in these radiation environments. (auth)

8824 CHANGES IN RADIOSENSITIVITY DURING THE IN VITRO GROWTH OF DIPLOID HUMAN FIBROBLASTS. Cox, R.; Masson, W. K. (Medical Research Council, Harwell, Eng.). Int. J. Radiat. Biol.; 26: No. 2, 193-196(Aug 1974).

A change in radiosensitivity has been demonstrated during the in vitro growth of diploid human fibroblasts. A feeder cell technique was used to improve and standardize the cloning efficiency of diploid fibroblasts cultured from normal human tissue; the cloning efficiency of viable cells on all dose plates was the same, and it was possible to obtain quantitative and reproducible results. X-ray survival curves of early passage (6 to 25 generation) diploid human fibroblasts were unshouldered and exponential. The D_0 for 250 kVp x rays with 6 to 25 generation cells was between 75 and 110 rad for different cultures. Unshouldered survival curves were also observed for early passage cells after ^{60}Co gamma irradiation (D_0 100 to 130 rad). In contrast, the only cells cultured beyond 35 generations in vitro showed a shouldered survival curve with an extrapolation number between 1.2 and 2.0. The implication is that later passage cells gain the ability to sustain sub-lethal radiation damage; the nature of this transition remains to be elucidated. (UK)

8825 RADIATION RESPONSE OF A SOMATIC CELL HYBRID. Limbosch, S.; Heilporn, V.; Lievens, A.; Decoen, J. L.; Zampetti-Bosseler, F. (Univ., Brussels). Int. J. Radiat. Biol.; 26: No. 2, 197-201(Aug 1974).

The sensitivities to x rays of Chinese hamster diploid cells and tetraploid synkaryons resulting from fusion of the former have been studied in order to investigate the factors controlling radiosensitivity of mammalian cells in culture. The nearly tetraploid synkaryons displayed, within experimental error, the same survival parameters as the parent, nearly diploid, cells. This lack of correlation between survival parameters and ploidy does not however rule out the possibility that the sites of lethal radiation injuries reside in the chromosomes. (UK)

8826 SURVIVAL AFTER X-IRRADIATION OF EXTREMELY HYPOXIC HUMAN CELLS CULTURED IN VITRO. Pettersen, E. O.; Oftebro, R.; Brustad, T. (Norsk Hydros Institutt for Kreftforskning, Oslo). Int. J. Radiat. Biol.; 26: No. 3, 305-310 (Sep 1974).

An investigation of the shapes of survival curves of extremely hypoxic human NHIK 3025 cells irradiated in suspension with 220-kV x rays suggested that two main types of damage may be inflicted on the cells. Below a threshold dose of about 2000 rads, a damage of type A dominated completely, whereas beyond that dose damage of type B was superimposed on the former, yielding a net survival relationship; this was compatible with an exponential relationship, with an increased slope relative to that of type A damage, over the dose-range investigated (2000 to 3000 rads). Pre-irradiation of the medium under hypoxic conditions gave results suggesting that the type B damage could be ascribed to toxic products produced on irradiation of the growth medium (medium effect). With other cells and different experimental conditions, this medium effect may appear at different doses and give rise to other shapes of curve. If this medium effect proves to be general, it will be necessary to study the two types of damage separately when comparing the effects of different sensitizers. (UK)

Radiation Effects on Microorganisms

Refer also to abstracts 8807, 8904, 8928, and 9011.

8827 SPONTANEOUS AND INDUCED MUTAGENESIS OF WESTERN EQUINE ENCEPHALOMYELITIS VIRUS IN CHICK EMBRYO CELLS WHICH DIFFER IN REPARATIVE ACTIVITY. Dubinin, N. P.; Zasukhina, G. D.; Nesmashnova, V. A.; L'vova, G. N. (Inst. of General Genetics, Moscow). Dokl. Biol. Sci.; 215: No. 1-6, 145-146(1974).

Translated from Dokl. Akad. Nauk SSSR; 215: No. 6, 1483-1484 (Apr 1974).

The survival rate of Western equine encephalomyelitis (WEE) virus after treatment with mutagens (uv radiation and methylmethane sulfonate) and the indices of the spontaneous mutability of the virus in two types of cells (normal and aleukemic chick embryo cells) differing in this reparative activity were determined. Differences were found in the indices of spontaneous and induced mutability of WEE depending on the reparative activity of the cell system used. It was concluded that the effect of a number of chemotherapeutic agents and virus inactivators varies depending on the activity of the reparation system. (ERB)

8828 EFFECT OF IONIZING RADIATION AND CHEMICAL METHYLATION UPON THE ACTIVITY AND ACCURACY OF E. COLI DNA POLYMERASE I. Saffhill, R. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Biochem. Biophys. Res. Commun.; 61: No. 2, 752-758(27 Nov 1974).

The activity of E. coli DNA polymerase I decreases on treatment with γ rays, methylnitrosourea, or dimethyl sulphate. In the case of the first two agents the decrease in activity is accompanied by a decrease in the accuracy of the enzyme in an in vitro assay. There is no detectable change in the ratio of DNA polymerase activity to 3′ – >5′ exonuclease activity on treatment. (auth)

8829 EFFECT OF CAFFEINE ON THE SURVIVAL OF UV-IRRADIATED HERPES SIMPLEX TYPE 1 VIRUS. Roubal, J.; Vonka, V. (Inst. of Sera and Vaccines, Prague). J. Gen. Virol.; 24: 381-383(Aug 1974).

Caffeine reduced the survival of uv-irradiated herpes simplex type 1 virus. The relative reduction of plaque count by caffeine was most pronounced in the second component of the survival curve. With more heavily irradiated virus, when multiplicity reactivation apparently played a major role, the caffeine effect was less marked. (auth)

8830 EFFECT OF GAMMA-RAYS ON SPIROCHAETES OF THE SPECIES BORRELIA ANSERINA, SAKHAROFF, 1891. Part 2. Changes in the Antigenic Structure. Dzhankov, I.; Surmov, I.; Lozeva, T. Vet. Med. Nauki (Sofia); 10: No. 4, 67-71(1973). (In Bulgarian).

It has been found that the treatment of Borrelia anserina spirochaetes with gamma rays from a cobalt source brings about changes in their antigenic structure. More pronounced are the changes at doses of 100,000 R than at 20,000 R. This may well account for the graded decrease in the virulence of the irradiated organisms that was established on a previous occasion. Gamma treatment at the rate of 20,000 up to 100,000 has not been shown to produce any effect on the type-specific antigens whereupon the irradiated strains remain in the same serotype position. (auth)

8831 THE INFLUENCE OF POSTIRRADIATION CULTIVATION OF THE STRAIN OF ESCHERICHIA COLI B/R T-TRP-HCR$^+$ ON THE PHENOTYPIC EXPRESSION OF TRP$^+$ MUTATIONS. Slamenova, D. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Vyskumny Ustav Onkologicky). Biologia (Bratislava); 28: No. 12, 949-954(1973).

Escherichia coli B/r $T^-trp^-Hcr^+$ strain cells were exposed to ultraviolet radiation and then cultivated in synthetic media containing nutrient broth of increasing concentration. A study was conducted into the effect of the cultivation conditions on the frequency of induced mutations, on the colony-forming ability of irradiated cells, and on the restoration of the overall protein synthesis after uv irradiation. No correlation was found between the frequency of induced trp$^+$ mutations and the intensity of proteosynthesis after uv irradiation. (auth)

8832 THE INFLUENCE OF AMINO STARVATION ON THE REACTIONS OF UV-IRRADIATED ESCHERICHIA COLI $K_{12}SR_{20}$ CELLS. Slamenova, D. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Vyskumny Ustav Onkologicky); Krejciova, A. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Biologicky Ustav). Biologia (Bratislava); 28: No. 9, 759-766(1973).

The effect was studied of pre-irradiation and of post-irradiation amino acid starvation on lethal and mutagenic effects of uv-irradiation and on the intensity of DNA degradation in irradiated cells of the E. coli $K_{12}SR_{20}$ strain. Starvation induced before irradiation increased the survival after uv-irradiation and decreased the uv-mutability and the degree of DNA degradation. Starvation induced after irradiation decreased the survival rate of cells, as well as the mutation frequency and the degree of DNA degradation. With combined pre-irradiation and post-irradiation starvation the number of surviving and mutated cells remained constant and DNA degradation was found to be lowest. The results show that no definite correlation exists between the degree of cell viability in the irradiated culture and the degree of DNA degradation, or the scope of mutability of the culture under investigation. (auth)

8833 NOTE ON SURVIVAL CURVES WITH SHOULDERS. Green, A. E. S. (Univ. of Florida, Gainesville); Burki, J. Radiat. Res.; 60: No. 3, 536-540(Dec 1974).

A two parameter nonlinear differential equation and solution that quite accurately characterize radiobiological survival curves are presented. The equation is an adaptation of a nonlinear rate equation first used by Verhulst to characterize the saturation of population growth. In the present context it appears capable of accommodating biological recovery, as manifested by the shoulder which appears in many survival curves. Data are based on studies on uv radiation effects on Escherichia coli. (HLW)

8834 QUANTITATIVE STUDY ON LEUCINE INCORPORATION IN MULTINUCLEATE CELLS INDUCED BY SENDAI VIRUS (38362). Pan, I. H.; Chen, J. Y.; Kao, I. Y.; Wei, C. I. (National Taiwan Univ., Taipei). Proc. Soc. Exp. Biol. Med.; 147: No. 2, 453-455(Nov 1974).

Chang conjunctival cells were treated with uv-inactivated Sendai virus. The resulting mixture of mono- and multi-nucleate cell was exposed to ^{3}H-leucine for 1 and 3 hr. The amount of leucine incorporated, as determined by autoradiographic technic, was nearly proportional to the number of nuclei per cell and to the duration of exposure to ^{3}H-leucine. (auth)

8835 CAFFEINE INHIBITION OF DARK-REPAIR: LACK OF REVERSAL BY ADENOSINE-(3′5′)-MONOPHOSPHATE. Mennigmann, H. D. (Univ., Frankfurt am Main). Int. J. Radiat. Biol.; 26: No. 2, 101-106(Aug 1974).

Adenosine-(3′5′)-monophosphate (cAMP) has been reported to reverse the inhibition by caffeine of dark-repair in uv-irradiated bacteria. No such effect was observed from cAMP, whether produced internally or added externally, on a number of bacterial strains and under a number of experimental conditions. (auth)

8836 HOST-CELL REACTIVATION IN MAMMALIAN CELLS. IV. Cell Culture Conditions Affecting Virus Survival. Lytle, C. D.; Benane, S. G. (Bureau of Radiological Health, Rockville, MD). Int. J. Radiat. Biol.; 26: No. 2, 133-141(Aug 1974).

Investigations are reported regarding the generality of host-cell reactivation (HCR) of uv-irradiated virus and factors which influence HCR. No significant differences were found in HCR ability (determined by D_{37}) in 18 different human fibroblast cultures for uv-irradiated herpes virus among cells from different organs or from individuals of different sex or age. Two aspects of culture "age" were: (1) the HCR ability of primary cultures increased somewhat with passage number; (2) infection of cultures at increasing times after subculture produced a marked decrease in the level of the second component of the two-component survival curve, as was also found when depleted medium was used. Normal, contact-inhibited mouse cells have a one component survival curve, whereas a transformed culture had an additional, less sensitive component. These combined data indicated that (1) several cell conditions have slight effect on HCR (as measured by D_{37}) and (2) conditions which inhibit cell-growth depress the level of the second component of the survival curve. (auth)

8837 SYNERGISTIC INTERACTION BETWEEN UV AND PROTONS IN CAUSING LOSS OF REPRODUCTIVE CAPACITY IN ESCHERICHIA COLI B/r. Neary, G. J.; Bance, D. A.; Cox, R. (Medical Research Council, Harwell, Eng.). Int. J. Radiat. Biol.; 26: No. 2, 187-192(Aug 1974).

The interaction between uv and protons has been shown to cause loss of reproductive capacity in E. coli B/r. The slopes of the survival curves of E. coli B/r exposed to protons were increased by preliminary doses of uv radiation, whether the proton-irradiations were given in oxic (sensitization factor 1.5) or anoxic (sensitization factor 1.7) conditions. Control experiments showed no such undoubted effect when the preliminary dose was also of protons. In addition, sensitization (sensitization factor ~1.4) of E. coli B/r to uv by a preliminary dose of protons was suggested by the results of a single experiment performed. No such significant synergistic effects could be demonstrated for E. coli B/r with (a) soft x rays followed by He ions (b) uv followed by He ions and (c) uv followed by soft x rays. It may be that the uv sensitization of E. coli B/r to ionizing radiation is not a general phenomenon but is dependent on the quality of the second radiation. (UK)

8838 ENERGY METABOLISM IN YEAST CELLS AFTER UV- AND X-IRRADIATION. Kiefer, J. (Univ., Giessen, Ger.). Int. J. Radiat. Biol.; 26: No. 2, 167-179(Aug 1974).

Respiration, fermentation, and fermentation under anaerobic conditions were measured in yeast cells exposed to moderate doses of uv- or x radiation to yield colony-forming abilities between 100 and 1%. Energy metabolism was followed for up to six hours. Since irradiated cells suffer a dose-dependent delay in division, the data were calculated in a per cell basis. It was found that energy metabolism always increased after low doses and declined after higher doses. For the case of uv, partial photoreactivability indicated the involvement of nuclear factors. The results are interpreted in terms of radiation-induced disturbance of cellular regulation. (auth)

Radiation Effects on Plants

8839 (STI/PUB-388) INDUCED MUTATIONS FOR DISEASE RESISTANCE IN CROP PLANTS. Panel Proceedings Series. Proceedings of a Conference Held in Novi Sad, Yugoslavia, June 4–8, 1973. (International Atomic Energy Agency, Vienna (Austria)). Jun 1974. 199p. (In French and English). (CONF-7306106). $10.00.

Separate abstracts were prepared for 11 of the 36 papers presented in these proceedings. The other 25 papers discuss the use of chemical mutagens in mutation breeding programs for disease resistance in crop plants. (ERB)

For abstracts of individual papers see: 8857–8867.

8840 (SZS-157, pp 12-14) PRINCIPLES OF THE HYGIENE EVALUATION OF THE COMBINED EFFECTS ON AN ORGANISM OF FACTORS OF A RADIATION AND NON-RADIATION NATURE. Liberman, A. N. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The mutagenic effects of various substances such as chemicals, insecticides, wastes from various industrial processes, and automobile exhausts are known and are being studied. However the combined effects of these substances and ionizing radiation are receiving little attention. The possible genetic effects of factors such as hf and vhf electromagnetic fields, ionization of the air, increased concentrations of ozone, and even noise in association with ionizing radiation require extensive study. The necessity for such studies is emphasized. (JSR)

8841 INDUCED CHLOROPHYLL MUTATIONS IN HARD SPRING WHEAT. Mamalyga, V. S.; Kulik, M. I.; Logvinenko, V. F. (Inst. of Molecular Biology and Genetics, Kiev). Dokl. Biol. Sci.; 215: No. 1-6, 126-128(1974).

Translated from Dokl. Akad. Nauk SSSR; 215: No. 1, 211-213 (Mar 1974).

Seeds of hard spring wheat were treated with fast neutrons, γ rays, or one of several different chemical mutagens and the frequency of chlorophyll mutations was determined. The mutagens found to be most effective in increasing the frequency and broadening the spectrum of chlorophyll mutations in hard wheat and its morphological mutants were fast neutrons, γ radiation, EMS, NMU, NEU, and DMS. (ERB)

8842 INDUCED MULTILOCULAR OVARY IN CAPSICUM ANNUM BY X RAYS. Subhash, K. (Osmania Univ., Warangal, India); Nizam, J. Curr. Sci. (India); 43: No. 23, 764-765(5 Dec 1974).

The effects of ionizing radiation on the locules of ovary in Capsicum annum was studied. Results are presented demonstrating a significant increase in the number of carpels and locules per ovary following x irradiation of dry seeds. The findings raise the possibility that radiation induction of locule number in c. annum is possible and if used in conjunction with other genetic and cultural techniques could prove to be of practical significance. (ERB)

8843 APPROACH TO INCREASE THE EFFICIENCY OF INDUCTION OF MUTATIONS IN RICE (ORYZA SATIVA L.). Chakrabarti, S. N. (Indian Agricultural Research Inst., Delhi). Curr. Sci. (India); 43: No. 23, 754-755(5 Dec 1974).

An approach for recurrent radiation treatment of rice appeared to be most useful in producing macro- and micro-mutations. Increased mutation frequencies were obtained by preirradiation with 5kR followed by a high dose irradiation. Preirradiation with high doses (30 kR) slightly reduced the mutation frequency. (ERB)

8844 INDUCED POLYGENIC VARIABILITY IN M_3 AND M_4 GENERATIONS OF BARLEY CULTIVAR C 164 FOR PLANT HEIGHT, SPIKE LENGTH, AND NUMBER OF SPIKELETS PER SPIKE. Gill, K. S.; Nanda, G. S.; Chand, K. (Punjab Agricultural Univ., Ludhiana, India). Genet. Agr.; 28: No. 3-4, 232-241 (30 Sep 1974).

Investigations were undertaken to make a comparative assessment of induced polygenic variability after treatment with different doses of EMS, gamma-rays and ^{32}P in C 164 variety of barley. The study revealed that the mean value was either unaltered or shifted towards negative direction than their respective controls in M_3 generation except for plant height in EMS (0.037%) and number of spikelets in gamma rays (40 kR and 70 kR), 32_p (2.5, 7.5, 10.0 μc/seed) treatments. There was no relationship between the dose of the mutagen and the magnitude of variability released. The lower concentration of EMS along with moderate doses of gamma-rays and 32_p were most effective, for inducing genetic variation for the characters under study. The genetic variability released appeared to be due to additive genetic differences which could be exploited by simple breeding procedures. (auth)

8845 INDUCED POLYGENIC VARIABILITY IN SORGHUM. Ramulu, K. S. (Agricultural Univ., Coimbatore, India). Genet. Agr.; 28: No. 3-4, 278-291(30 Sep 1974).

Mutagenic effects of radiations and EMS were studied on various quantitative traits in the M_1 to M_4 of Sorghum subglabrescens. Radiation and EMS treatments caused a decrease in the mean of all the quantitative characters in the M_1 generation. In the M_2 also, there was a decrease in the mean values, but it was not as drastic as in the M_1. In the M_3 and M_4 generations, the mutagenic treatments caused a decrease as well as an increase in the mean compared to the control. The phenotypic frequency distributions obtained for plant height, weight of ear, and weight of grain in the

M_3 and M_4 generations showed that the incidence of polygenic variation in the positive and negative directions is nearly equal in the treated population. The amount of genetic variability was much enlarged in different quantitative characters in M_3 and M_4 following treatments with radiations and EMS. The different quantitative traits responded differently to mutagenic treatments for the induced variation. (auth)

8846 RADIATION RESPONSE IN RICE. Vairavan, S.; Sivasubramaniam, S.; Wifred, M. W.; Srinivasalu, N. Madras Agr. J.; 60: No. 4, 288-289(1973).

Radiation response of the var. ADT 25 as expressed in the panicle characters has been investigated. X irradiation particularly the lower dose (10kR) induced greater amount of variability in the M_2 generation as compared to the control in the traits, panicle length, number of grains, and 100 grain wt. However, for single plant yield, the variability was found to increase as the dosage increased. The variability observed in these cases may be either due to mutation of a combination of mutation recombination. The enhanced variability through irradiation could be exploited to evolve new genotypes. (Indian Sci. Abstr.)

8847 CHANGE IN THE CONTENT AND INTERRELATION OF THE TROPAN ALKALOIDS IN PLANTS TREATED WITH ULTRAVIOLET LIGHT. Yankulov, J. (Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria). Inst. po Genetika). Rast. Nauki; 8: 15-23(1972). (In Bulgarian).

Russian and English summaries.

Ultraviolet light as affecting the accumulation of tropan alkaloids in the Atropa (Atropa caucasica Kreyer) and Minka (Datura godronii Danert) varieties was studied in trials in 1969–1971. Seeds and roots were subjected to preplant treatment, and grown plants, three days prior to harvest, were treated for 1 to 90 minutes. The experiments showed that ultraviolet light treatment of roots and seeds brings about an increase in the alkaloids content of grown plants, namely, by 32.1% of that of leaves, by 13.9% of top-growth and by 5.9% of roots in the belladonna and by 21.7% in the alkaloids content of thorn apple leaves. The increase in the alkaloids content of plants grown from treated seeds is due to a larger amount of atropine. The total alkaloids yield of treated belladonna plants rises substantially, 127.2%, and of thorn apple plants, sharply, 196.4%, in comparison with untreated plants, respectively. (auth)

8848 CULTIVATION OF NEUTRON IRRADIATED ZINNIA ELEGANS JCAQ. Seeds. II. Inui, T.; Shimaokda, T.; Niwa, T.; Nakamura, K. (Kinki Univ., Osaka). Kinki Daigaku Genshiryoku Kenkyusho Nenpo; 10: 19-27([nd]). (In Japanese).

The seeds of Zinnia Elegans JCAQ were neutron-irradiated and their growth and transformation were observed. Neutron irradiation was carried out in the same way as in earlier experiments. The more irradiation was added, the smaller germination and growth were observed. The stem heights and the number of lateral branches showed the same results as above mentioned. Many transformations were observed but the relations between the irradiation and its effects were not clearly defined. At the same time the seeds obtained from the plants cultivated last year were again cultivated. From their seeds, analogous results to those of last time were obtained. (auth)

8849 EFFECTS OF IONIZING RADIATION AND GROWTH REGULATORS UPON ABSCISSION IN EXPLANTS OF PHASEOLUS AND IMPATIENS. Dwelle, R. B. Bozeman, MT; Montana State Univ. (1974). 151p. University Microfilms Order No. 74-24,008.

Thesis (Ph. D.).

Stem-petiole explants from the lower pulvinus of the primary leaves of Phaseolus vulgaris L. cv Red Kidney and from Impatiens sultanii Hook cv Scarlet Baby were exposed to varying dosages of gamma radiation. With bean, irradiation of 175 to 525 kR significantly accelerated the onset of abscission with a maximum response at 175 to 280 kR. Higher dosages (beginning at 600 to 700 kr) usually prevented abscission. With Impatiens, 18 to 35 kR significantly accelerated both the onset of abscission and possibly the initial abscission rate; 350 kR cut the time to 100% abscission in half and substantially accelerated the initial abscission rate, compared to the nonirradiated controls. Inhibition of abscission in Impatiens was not possible with the available dose rate (35 kR/hour). The accelerating effect of ionizing radiation was apparently due primarily to a reduction in auxin activity, thus accelerating the shift from the relatively ethylene-insensitive Stage I to the ethylene-sensitive Stage II. In vitro irradiation of exogenous auxin in agar substantially reduced the abscission-delaying effects of the auxin. The low-dosage accelerating effects of the ionizing radiation were negated by exogenous auxin application, either prior to or following irradiation. Apparently due to this reduction in auxin activity, irradiation hastened sensitivity to exogenous ethylene. The accelerating effects of ionizing radiation may be due secondarily to increased levels of endogenous ethylene. With bean tissues, exposures of 262 through 1500 kR of gamma radiation increased the measurable levels of endogenous ethylene released into the ambient air within two or three days after irradiation. By 7 to 10 days after irradiation, the ethylene levels were often comparable for all tissues (irradiated and non-irradiated). An increased mobilization of calcium from the abscission zone may be a contributing factor in the radiation-induced acceleration of abscission. Histochemical examination verified that transverse cell divisions apparently do not occur in the abscission zone of Impatiens explants prior to separation. Contrary to previous report, divisions were observed in the lower pulvinar abscission zone of bean-petiole control explants; however, ionizing radiation apparently inhibited most divisions in the irradiated bean explants. (Diss. Abstr. Int., B)

8850 COMBINED EFFECTS OF COBALT-60 IRRADIATION AND SELECTED HERBICIDES ON SPIRODELA POLYRRHIZA. Mahar, H. Ann Arbor, MI; Univ. of Michigan (1974). 121p. University Microfilms Order No. 74-25,259.

Thesis (Ph. D.).

This study was initiated to determine the combined effects of ^{60}Co irradiation and selected herbicides on a representative plant species (Spirodela polyrrhiza) and to provide a model for assessing the combined effects of toxicants on natural ecosystems. S. polyrrhiza (duckweed) was grown hydroponically under optimal laboratory growth conditions; responses monitored included net growth, biomass, protein content, and mitotic index. Net growth, by optical planimeter determination, was the most precise of the plant responses investigated. Acute ^{60}Co irradiation doses ranged from 500 to 5000 rads; chronic and acute herbicide exposures were: atrazine (1×10^{-7} M to 1×10^{-6} M); CIPC (5×10^{-7} M to 5×10^{-6} M); and paraquat (acute; 1×10^{-10} M to 1×10^{-7} M). Various models for determining combination interactions are discussed. Interpretation of experimental results according to three concepts of joint action (similar, synergistic, or independent) proved an adequate means of assessing S. polyrrhiza response to those toxicants when evaluation of data was accomplished using logistic transformed regression equations of the dose-response curves. The similar joint action model was found to consistently overestimate the experimental response to joint application of atrazine-^{60}Co or CIPC-^{60}Co. When a factor expressing the coefficient of antagonism (K) between components is included in the model, one is able to accurately predict S. polyrrhiza response for the total dose applied and for varying proportions of each component of the total doses applied. The possibility of using this model to predict responses of individual plant species or plant communities to exposure to toxicants within an ecosystem is considered. (Diss. Abstr. Int., B)

8851 DOSE-RESPONSE OF CELL PROLIFERATION IN DIPLOID AND MIXOPLOID CULTURED ROOT EXPLANTS. Burholt, D. R.; Hof, J. V. (Brookhaven National Lab., Upton, NY). Int. J. Radiat. Biol.; 26: No. 2, 181-185(Aug 1974).

Pisum sativum root explant was selected as a tissue in which the influence of ploidy level and the degree of mitotic activity on cell proliferation after irradiation could be evaluated. The dose-response of cell proliferation in diploid and mixoploid calluses irradiated with ^{137}Cs gamma radiation immediately after explantation, when no cells were dividing, was compared with that after three days in culture, when cell proliferation was at a high level. The results indicated that the non-proliferating explants if irradiated and then stimulated were more radiosensitive for proliferation than the actively proliferating explants. Measurements of cell number, mitotic index, and per cent diploid mitoses suggested that the proliferations of autopolyploid and diploid cells were nearly equally sensitive to irradiation. The results support the hypothesis that cessation of mitotic activity after irradiation results more from premature differentiation than from genetic effects. (UK)

8852 RADIATION-INDUCED CHANGES IN CATALASE, LIPASE, AND ASCORBIC ACID OF SAFFLOWER SEEDS DURING GERMINATION. Singh, B. B. (Jawaharlal Nehru Agriculture Univ., Jabalpur, India). Radiat. Bot.; 14: No. 3, 195-199(Sep 1974).

Safflower seeds were γ irradiated with exposures of 0, 10, 20, 25, 30, 35, 40, 45 and 50 kR. Radiation-induced changes in germination, catalase and lipase activities in seeds and ascorbic acid content in dry seedlings indicated that doses up to 20 kR stimulated germination as well as catalase and lipase activities. However, heavier doses produced inhibitory effects. These effects were maintained even in the M_2 generation. (auth)

8853 DEVELOPMENT OF GAMMA-IRRADIATED ACCESSORY BUDS OF SWEET CHERRY, PRUNUS AVIUM L. Katagiri, K.; Lapins, K. O. (Department of Agriculture, Summerland, British Columbia). Radiat. Bot.; 14: No. 3, 173-178(Sep 1974).

The development of accessory buds on non-irradiated dormant scions varied among four sweet cherry cultivars. Bing cherry had few dormant buds at the accessory bud sites. With Lambert, Stella, and Van scions, most nodes had developed accessory buds although they varied in their degree of development. Accessory buds appeared to be more sensitive to γ radiation than were the main buds, the LD_{50} for the two groups being 2.75 and 4.50 kR, respectively, at an exposure rate of 8.4 kR/min. Removal of the main bud forced the accessory buds to produce shoots, but did not stimulate the origin of accessory buds at sites where the buds were lacking; non-irradiated and irradiated buds reacted similarly to the treatment. Treatments with a cytokinin, 6-benzylaminopurine (BAP), combined either with adenine or with both adenine and indoleacetic acid (IAA), promoted development of irradiated accessory buds while gibberellin A_7 retarded their development. (auth)

8854 HYPOXIC PROTECTION AT LOW X-RAY DOSES. A Fractionated Dose Study Using Vicia Faba. Winston, B. M. (Churchhill Hospital, Oxford); Berry, R. J.; Oliver, R. Int. J. Radiat. Biol.; 26: No. 3, 251-258(Sep 1974).

Inhibition of root growth in Vicia faba was used to measure the oxygen enhancement ratio (oer) at small doses of x rays. Measurable biological effects were obtained by giving up to 11 fractions of each small dose, allowing sufficient time for intracellular repair between fractions. No variation of oer with dose was seen. This result is in agreement with the suggestion that the extrapolation number is unaffected by the state of oxygenation at least down to < 100 ppm of O_2. (auth)

8855 EFFECTS OF ACUTE GAMMA IRRADIATION ON THE CONCENTRATION OF AMINO ACIDS AND PROTEIN-NITROGEN IN ZEA MAYS. Igbal, J.; Kutacek, M.; Jiracek, V. (Ceskoslovenska Academie Ved, Prague). Radiat. Bot.; 14: No. 3, 165-172 (Sep 1974).

Hybrid corn seeds were irradiated with 0, 5, 10, 15, and 20 kR of ^{60}Co γ rays. As a result of irradiation the totals of free amino acids of 10-day-old seedlings increased significantly at 10 and 15 kR in roots, while in shoots they showed a decrease at all exposures, except for 20 kR where there was a small increase. The bound amino acids composition in roots showed a significant increase in lysine and valine concentrations at 5 kR. The levels of several of the bound amino acids in shoots increased significantly at all exposures. The alpha-amino nitrogen in shoots decreased at all treatments (except at 20 kR), while protein nitrogen increased significantly at all exposures. (auth)

8856 TRANSPIRATION AND STOMATAL OPENING OF X-IRRADIATED BROAD BEAN SEEDLINGS. Roy, R. M. (Sir George Williams Univ., Montreal). Radiat. Bot.; 14: No. 3, 179-184(Sep 1974).

Transpiration, stomatal opening, and osmotic pressure of epidermal and guard cells were measured in non-irradiated Vicia faba seedlings and at various times following exposure to 250 R of 230 KVp x rays. Significant reduction in total daily water loss per plant was detected in irradiated plants which was largely associated with substantial inhibition of leaf proliferation and growth; however, water loss per unit leaf area was significantly reduced in irradiated plants at 14 to 16 days post irradiation. The reduced transpiration was associated with inhibition of stomatal opening from the 9th to 16th day after irradiation. The osmotic pressure of epidermal and guard cells was compared in control and irradiated plants; the osmotic pressure of epidermal cells in irradiated plants appeared to be slightly higher than that of epidermal cells of non-irradiated plants. However, the slight osmotic pressure changes of epidermal cells in irradiated plants did not appear to be a major factor contributing to inhibition of stomatal opening in irradiated plants under the growth conditions of the experiments. (auth)

8857 SCOPE AND AIMS OF THE CO-ORDINATED RESEARCH PROGRAMME ON INDUCED MUTATIONS FOR DISEASE RESISTANCE IN CROP PLANTS. Micke, A. (Atomic Energy in Food and Agriculture, Vienna). pp 3-7 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF-7306106-.

The FAO/IAEA/SIDA Co-ordinated Research Program on Induced Mutations for Disease Resistance in Crop Plants was initiated in 1971 following the advice of a panel of experts which met in Vienna in 1970. It aims at the development of techniques to induce mutations for disease resistance, to detect such mutations, and to utilize them in plant breeding programs for improved crop varieties. The program considers non-specific types of resistance as highly desirable and attempts to examine mechanisms underlying such types of host/pathogen relationships. In the short initial period of this research program, participants reported detection of blast resistance in rice, rust resistance in wheat, mildew resistance in millets, and tolerance against septoria in wheat. (auth)

8858 DISCRIMINATION BETWEEN SPECIFIC AND NON-SPECIFIC REACTIONS IN THE HOST: PATHOGEN RELATIONSHIP. Favret, E. A.; Sarasola, J.; Solari, R. M. (Centro de Investigaciones en Ciencias Agronomicas, Castelar, Argentina). pp 23-34 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF-7306106-.

A hypothesis for a molecular explanation of the host : pathogen relationship from which it is possible to discriminate between genes controlling specific and non-specific disease reaction is presented in this paper. In this way a crucial test has been planned to identify both types of genes, suggesting that the barley-mildew system is an adequate one for this purpose. The method is based on the use of induced mutagenesis. Data on induced mutations for Septoria nodorum reaction in hexaploid wheat, after treatments with fast neutrons are presented. This case is demonstrative of a situation where little genetic variability for disease reaction is present. (auth)

8859 BREEDING FOR STEM RUST RESISTANCE IN OATS. McKenzie, R. I. H.; Martens, J. W. (Canada Dept. of Agriculture, Winnipeg). pp 45-48 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF-7306106-.

A total of about two million M_2 plants of the stem rust susceptible varieties Weikus, Fraser, Tiger, Lodi, and NY 5832 from treatments with gamma radiation (10 kR and 30 kR), fast neutrons (400 and 600 rad), and diethyl sulphate (0.02 and 0.04M at 30°C for 1 h) were grown on a 1-ha area at Morden. A good artificial epidemic of stem rust race C 10 was initiated but crown rust coming from a stray plant of the alternate host buckthorn created problems. No resistance to crown rust was noted and no good stem rust resistant plants were found. Thirteen plants showing an intermediate reaction were collected and seedling and adult tests with stem rust races will be carried out. The degree of resistance in the field was low and the reaction very similar to that of plants possessing pg 9. Initial seedling rust tests have shown four to have resistance to race C 10. These four all come from DES treatments in Lodi, Weikus, and NY 5832. Adult plant rust tests indicated some stem rust resistance. The four with seedling resistance have been test-crossed for further genetic studies. In the spring of 1972 seeds of Sioux, Stormont, Random, and Yamaska were treated with gamma rays and EMS and sown one week later at Glenlea. (auth)

8860 INDUCED MUTATIONS FOR DISEASE RESISTANCE IN WHEAT AND BARLEY. Hanis, M. pp 49-56 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF- 7306106-.

A programme has been planned that aims at inducing new sources of disease resistance and improving disease resistance in the superior yielding wheat and barley varieties. The vertical type of resistance has mostly been selected for the time being. Several new exotic and/or local genotypes are treated each year. Dry seeds are irradiated (X- or gamma-rays, thermal neutrons) or treated with EMS at doses resulting in LD_{30} in wheat and LD_{50} in barley. Mutations for disease resistance are detected during artificial infection in the greenhouse in M_2 generation, and under artificial epiphytotic field conditions in M_2 and successive generations. The detected mutants are tested for resistance to broader spectra of races available. Until this time, treated populations of Diana I (ČSSR), Salzmünder Bartweizen, Caribo, Progress, Habicht, Kranich (Federal Republic of Germany), Poros, Fakir (Democratic Republic of Germany), Grana (Poland), and Mironovskaya 808 (USSR) cultivars of bread wheat, and Dobrovický 8, Valtický, and Diamant (ČSSR) cultivars of barley have been screened. There were obtained 15 mutants resistant to stripe rust (frequency 0.011 per 100 M_2 plants), one to leaf rust (0.005), 11 to stem rust (0.003-0.05), 35 to mildew (0.005-0.061) in wheat, and 10 mutants resistant to mildew (frequency 0.0012-0.0089) in barley. The value of mutants differs from a practical breeding point of view. It is assumed that a number of mutations for a desired character have to be induced in order to find a valuable mutant for a breeding programme. (auth)

8861 MUTATIONAL AND INDEPENDENT ORIGIN OF MUTANTS INDUCED BY SEED TREATMENT OF SELF-POLLINATED PLANTS. Joergensen, J. H. (Danish Atomic Energy Commission, Risoe). pp 57-66 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF-7306106-.

Information on the mutational and independent origin of mutants is essential in order to reach conclusive results in mutation research and mutation breeding. Methods of obtaining this information are discussed in relation to simply inherited and easily identifiable mutations induced by seed treatments in self-pollinated plants. The information on the mutational origin of mutants requires a distinction between newly arisen mutations and contaminations (by, for example, outcrossing and admixture); the problem may be by-passed by prevention of contamination; and be solved by applying screening techniques selective for mutants, by labelling the mutation material with a unique genetic marker, or by utilizing the specific characteristics of the chimeric structure of the mutated M_1 plant. The information on the independent origin of mutants is obtained by separate handling of each M_1 plant and its progeny on the assumption that a mutation, e.g. for disease reaction, is induced only once in each M_1 seed. The "chimera method" (ad 4) is a simple method which may yield the needed information; it involves space planting of the M_1 seeds, harvesting of each M_1 plant singly, screening for M_2 mutants in two or more primary spikes or branches of each M_1 plant, and determination of the mutant gene segregation from a heterozygote. If chimerism of a mutated M_1 plant is demonstrated, this is a proof that its M_2 mutants have originated from a newly arisen mutation. The occurrence of chimerism in mutated M_1 plants of two-rowed barley is illustrated by chlorophyll mutations induced by gamma rays and diethyl sulphate; of 1519 chlorophyll mutant clusters, 1331 (88%) showed definitely and 127 (8%) suggested that the respective M_1 plants were chimeric; only 61 (4%) came from apparently non-chimeric M_1 plants. (auth)

8862 INDUCED MUTATIONS FOR DISEASE RESISTANCE IN WHEAT AND FIELD BEANS. Abdel-Hak, T.; Kamel, A. H. pp 69-77 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF-7306106-.

This study aims to induce useful mutations in wheat resistant to rusts and in field bean resistant to rust and chocolate spot. A brief review dealing with the disease situation of wheat in the Near East is given regarding rust race spectrum, behavior of indigenous and exotic wheats in the region, and genes governing resistance. A resumé is also given on rust and chocolate spot of field bean. In Egypt, earlier studies directed at induced mutations in wheat varieties were carried out. The diploid Einkorn, the tetraploids Baladi 116 and Baladi Bahtim, as well as the hexaploid varieties, Tosson, Giza 144, and Giza 150, were subjected to different ^{60}Co doses. From Tosson, a highly susceptible variety to the three rusts, some mutants were selected that proved to be resistant to yellow rust while susceptible to leaf rust, or vice versa; other lines were segregated in respect to their reaction to stripe or leaf rust or both. All selected mutants segregated in reaction to stem rust. Some plants resistant in M_3 to the three rusts were also selected from the same variety. Similarly, mutants showing more rust resistance than the original Giza 150 wheat variety were selected. In the present study 200 g of different wheat cultivars were subjected to 10, 15, and 20 krad of ^{60}Co gamma rays and planted at the Bahtim Agricultural Experiment Station. Germination tests in the laboratory and in the field proved that Dakar 52 variety (tetraploid) is sensitive to the doses used. Late maturity was noticed in different treatments in varying degrees. Chlorophyll mutation, sterility, and malformation of spikes were found in rare individual plants. At the Sakha Agricultural Experiment Station, 800 seeds of different field-bean varieties subjected to 3, 5, and 7 krad were planted. No deleterious effect was found in the different treatments except in the case of the 7-krad treatment. Future plans for the coming year within the five-year research program are given. (auth)

8863 REPORT OF MUTATION BREEDING FOR MILDEW AND RUST RESISTANCE OF WHEAT IN HUNGARY. Kiraly, Z. (Research Inst. for Plant Protection, Budapest); Barabas, Z. pp 85-88 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF-7306106-.

About 58,000 winter wheat seedlings from seeds treated with ^{60}Co gamma irradiation were screened for resistance to powdery mildew under greenhouse conditions in the M_1. No dominant mutations were found. Second, 130,000 seedlings of M_2 and M_3 of winter wheat were screened for resistance to powdery mildew in the greenhouse by applying artificial inoculation. About 100 resistant seedlings were found and are now grown in the rust and mildew nurseries for multiplication and further selection. Furthermore, 12,000 seedlings of M_2 of Bezostaja irradiated with fast neutrons were screened in the greenhouse for mildew resistance. About 40 plants were found to be resistant. They were planted in the nursery following appropriate vernalization. Then 120,000 adult plants in M_2 were inspected in both rust and mildew nurseries. Of those 0.6 to 0.9% exhibited field resistance to powdery mildew. In 1973 rust and mildew resistance of the progenies of irradiated seeds were tested in the adult stage in a stem rust nursery and a leaf rust nursery. Artificial inoculation of the spreader rows was carried out with mixtures of different physiological races of Puccinia graminis and P. recondita. Interspecific wheat hybrids have been irradiated with fast neutrons for the induction of translocations of chromosomes. M_1 of irradiated hybrids were sown for multiplication of the stock material. A special experiment was carried out for determining the spread of the inoculum of leaf rust in different cultivars. About 50-m-long plots were arranged in a round "cake form" with the inoculum in the centre of the cake. The extent of spore production and the speed of the development of epidemics will be determined in different cultivars to assess field resistance and/or tolerance. The immune type resistance is without any visible symptoms and regarded as the result of the mose effective host defence. It is shown that, in spite of the symptomless state, plants exhibiting immune-type resistance have an increased peroxidase activity. In other words, this type of resistance cannot be regarded as symptomless from a physiological point of view. The biochemical basis of plant resistance to infectious parasites has not yet been established. A new possibility to detect race-specific resistance is the comparison of proteins in host cultivars and races of pathogens by applying serological methods. Some preliminary indications in the literature show that a compatible host-pathogen interaction (susceptibility) is characterized by antigenic proteins which are common in plant and in the pathogen. In the case of resistance there are no common antigenic proteins in the host and pathogen. Antisera have already been made specific against proteins in wheat cultivars Khapli and Reliance. Antisera have been stained with a fluorescent compound. Antisera, thus labelled, will be combined with germinated spores of various races of Puccinia graminis for determining common antigenic proteins in the pathogen. In addition, antisera of the host will be combined with host proteins and host proteins thus labelled (stained) will be reacted with germinated spores of different rust races to reveal specific combinations of proteins between host and pathogen both in compatible (susceptible) and incompatible (resistant) cases. These investigations will be completed in 1974. At present, antisera of two wheat cultivars have been labelled. (auth)

8864 MUTATION BREEDING FOR RESISTANCE TO DOWNY MILDEW AND ERGOT IN PENNISETUM AND TO ASCOCHYTA IN CHICKPEA. Murty, B. R. (Indian Agricultural Research Inst., New Delhi). pp 89-100 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF-7306106-.

Downy mildew and ergot on millet and Ascochyta on chickpea have limited the exploitation of heterosis in the former and reduced the yield potential of chickpea. Mutational rectification of the above material with ^{60}Co to irradiate seeds was undertaken in this project. The results on millet have indicated that induced variation for resistance is substantial. The recovery of mutants resistant to downy mildew, from the B-line, the fertile counterpart of the male sterile Tift 23A is high ($\simeq$ 1/3000) but needs to be tested over seasons for stability of resistance and male sterility and complete restoration of pollen fertility in their hybrid combinations with other inbreds. Three such mutant lines with from zero to only traces of infection and complete maintenance of male sterility are isolated and are in M_5 generation. Similar work on two inbreds has resulted in the isolation of resistant mutants. The reconstituted hybrids using the resistant male steriles and the corresponding male counterpart mutants yielded 25 to 80% more than the corresponding controls and up to 200 kg/ha of more grain over the best tolerant hybrid, HB3, available so far. These male steriles are expected to be released after another cycle of selection and backcrossing to the A-line. Substantial differences are detected in the response of other inbreds measured by the frequency (up to M_4) of mutants resistant to downy mildew, and by the vigour, maturity and restoration of pollen fertility of resistant mutants, pointing to the need for a proper choice of an inbred for irradiation. Differences among the resistant West African lines are found in their sensitivity to mutagenic treatment and pattern of variation for disease resistance, plant type and maturity. Among them, IP 1967 and Kano 2778 are promising. No new cytoplasmic male steriles have appeared so far in the treated West African material. Their frequency of occurrence appears to be much lower than that for disease resistance. The search for resistance to ergot has not so far been successful. The appropriate dose for millet appears to be 25 kR for seeds equilibrated for uniform moisture content over anhydrous $CaCl_2$ for 24 h. A dose of 35 kR is highly lethal with extremely low seedling survival aggravated by adverse season. The M_1 generation of chickpea treated with 10 kR is still in the field. A method of creating artificial epiphytotics of ergot has been successfully developed and tested on a laboratory scale. Chickpeas have been treated with 10 kR. The M_1 generation has been grown in the field. (auth)

8865 SELECTION FOR BLAST-RESISTANT MUTANTS IN IRRADIATED RICE POPULATIONS. Kwon, S. H. (Korea Atomic Energy Research Inst., Seoul). pp 103-115 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF-7306106-.

The present study is under progress to select for blast disease resistant mutants from the irradiated populations of two leading varieties. The varieties used in this investigation were Pung-kwang, a blast susceptible Japonica type, and Tong-il (IR-667), a blast-resistant Indica type. The upland short-row method for screening blast-resistant mutants was used; 9760 M_3 lines of the variety Pung-kwang, tested in the blast nursery in the summer of 1972, and 7 lines and 15 individual plants of blast-resistant mutants were selected. Of the variety Tong-il, 1404 M_3 lines were put in the growth room during the winter of 1972-1973. Since the results of this test were inconstant, 1083 lines will be re-tested in the greenhouse. For this screening test, a mixture of six new isolates obtained from the Tong-il variety and an old local race were used. To support the major investigation in selecting blast-resistant mutants, new races were isolated from the variety Tong-il, and the new isolates are to be classified with differential varieties. Spores of a local blast race were irradiated with X-rays and the changes of the pathogenicity are under investigation. To determine the cause of resistance in the rice variety Tong-il that is at present resistant to the blast disease, contents of nitrogen, silica, and flavonoid in rice plants were determined. In this investigation, a positive correlation was expected between nitrogen content and susceptibility of blast disease, whereas silica and flavonoid contents were expected to be negatively associated with blast disease. However, nitrogen content in the variety Tong-il was rather higher than in the susceptible variety Pung-kwang, while the silica and flavonoid contents were both higher in the susceptible variety Pung-kwang. (auth)

8866 TOLERANCE OF SEPTORIA NODORUM BERK. BY WHEAT: METHODS OF INFECTION AND SELECTION BY MUTAGENESIS. Broennimann, A.; Fossati, A. (Stations Federales de Recherches Agronomiques, Zurich). pp 117-123 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974). (In French).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF-7306106-.

The paper describes the method of artificial infection with Septoria nodorum Berk. and gives some of the results of the study on tolerance for which it was used. It then proposes a system for the selection of tolerant mutants. This consists in large-scale selection over a period of two generations, followed by pedigreeing. The initial results, which are summarized in the paper, confirm the effectiveness of mutagenesis as a means of obtaining mutants which tolerate Septoria nodorum. They also confirm the value of the artificial infection technique. (auth)

8867 SCREENING INDUCED MUTATIONS FOR RESISTANCE TO LEAF RUST IN WHEAT. Borojevic, K. (Univ. of Novi Sad, Yugoslavia). pp 133-146 of Induced Mutations for Disease Resistance in Crop Plants. Vienna; International Atomic Energy Agency (1974).

From a research co-ordination meeting on induced mutations for disease resistance in crop plants; Novi Sad, Yugoslavia (4 Jun 1973). See STI/PUB-388; CONF-7306106-.

To test resistance to leaf rust, 130 mutant lines were taken, which were selected as mutations for quantitative characters in earlier experiments. The lines originated from four outstanding cultivars: Campodoro, Mara, San Pastore, and Bankut 1205, all susceptible to leaf rust. The mutant lines in the seedling stage were tested to the prevalent races 61 and 77 of Puccinia recondita tritici. On an average, the development of fungus took two weeks, and the estimation was made by reading the type of infection and the intensity of infection. In most cases the type of infection was 4 (susceptible) and there were no differences between the mutant lines and the control lines. Only four lines of 130 showed segregation in the type of infection between 0 and 4. In the intensity of infection, there were more differences between tested lines. (auth)

Radiation Effects on Animals

Refer also to abstract 8833.

Man

Refer also to abstracts 8613, 8623, 8624, 8674, 8799, 8800, 8811, 8816, 8822, 8947, 8948, 8949, 8951, 8952, 9015, 9053, 10150, 10287, 10410, 10420, 10421, and 10466.

8868 (BNL-19244) THRESHOLD PROBLEM IN ECOSYSTEMS. Woodwell, G. M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 14p. (CONF-740734-2). Dep. NTIS $4.00.

From conference on mathematics and the perturbations of ecosystems; Alta, Utah, USA (2 Jul 1974).

Initial appraisals of hazards of ionizing radiation are commonly low and lead to risks that are later considered unacceptable. The proof is in continuously diminishing permissible exposures as knowledge of the biotic effects of ionizing radiation has improved over more than 60 years. Estimates of maximum permissible exposures for man have declined in a pattern that has been repeated for many toxins. The conclusions are that man-controlled or man-built systems must approach in total effects on the biosphere those they replace. Biotic resources are essential in maintenance of the biosphere; their preservation will require a revolution in the design of human activities —and especially in the design of cities. In the next years competitive advantages will accrue to any society that succeeds in assuring a continuous supply of its own essential resources. This objective presents a complex series of challenges to science to recognize resources that are essential and to design efficient systems for using them in stable patterns. The assumption of thresholds for effects on ecosystems with its guarantee of progressive pollution and impoverishment seems not to be a part of this new calculus of environment. (auth)

8869 (LA-5799-MS) TECHNIQUES FOR VISUALIZING PION TREATMENT PORTS AT LAMPF. Barnes, J. E.; Hutson, R. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1974. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

One can determine useful information about the size and stopping distribution of a therapeutic negative pion beam within a patient if one measures the spatial distribution of the beam in a plane above the patient and at right angles to the beam axis and combines the results of this measurement with previously measured divergence properties of the beam. A film technique for performing this determination is proposed. (auth)

8870 (LA-UR-74-1400) COMPUTER MODELING OF NEUTRON DOSE AT VARIOUS LOCATIONS WITHIN THE BODY DURING PION RADIOTHERAPY. Schillaci, M. E.; Roeder, D. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 17p. (CONF-740844-1). Dep. NTIS $4.00.

From 5th international conference on the use of computers in radiation therapy; Hanover, New Hampshire, USA (19 Aug 1974).

The dose due to neutrons produced by nuclear capture of negative pions during radiotherapy is calculated at various locations within the body for two treatment volumes and positions. These calculations are a continuation of work reported earlier (Schillaci and Roeder, 1973) on neutron whole-body dose using a spherical tissue model and utilizing the same Monte Carlo transport code ANDY. Here, we model the head, neck and torso using combinations of spheres and cylinders. We include the spinal column, rib cage, and skull for bone, the brain, lungs, and heart for specific organs. The remainder of the material of the model is approximated to be the chemical composition of soft tissue. The neutron source is taken as the region of stopped pions (treatment volume) with the starting position and direction of the neutrons being randomly and uniformly distributed. The resulting dose to specific organs and bodily regions is calculated as a fraction of the treatment dose. (auth)

8871 (NP-20222) RADIOACTIVE SURVEILLANCE IN 1973. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). [nd]. 71p. (In French). Dep. NTIS (US Sales Only) $6.75.

The results of the monitoring of the radioactivity of the environment and of some foods made in France, Bolivia, Chile, Columbia, Equador, Peru, and French overseas territories are reported in tabular form. The milk and vegetable contamination is given. An evaluation was made of the order of magnitude of the irradiation to the exposed individuals. (JSR)

8872 (SSI-1974:016) EXPERIENCES OF INFORMATION GIVEN TO THE PUBLIC ABOUT QUESTIONS ON RADIATION PROTECTION. Loefveberg, S. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Jun 1974. 5p. (In Swedish). (CONF-740671-1). Dep. NTIS (US Sales Only) $4.00.

From meeting of Nordic Society for radiation protection; Helsinki, Finland (5 Jun 1974).

A survey is made of the education, information and propaganda to the public of Sweden about radiation hazards. Discussions concerning nuclear weapons, nuclear explosions, radon in mines, isotopes on identity cards, and nuclear power plants are analyzed and examples of their use in propaganda are given. (SW)

8873 (SZS-157) RADIATION PROTECTION, ENVIRONMENT, AND THE POPULATION. First Seminar, Potsdam, October 16–21, 1972. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Mar 1974. 292p. (In several languages). (CONF-7210124-).

Separate abstracts were prepared for the 47 papers presented in these proceedings. (ERB)

For abstracts of individual papers see: 8192, 8193, 8206, 8612–8624, 8633, 8634, 8652, 8662–8664, 8674, 8761, 8840, 8874–8876, 8900–8902, 8947–8952, 8955–8957, 8962, 8963, 8974, 8975, 10319, 10420, and 10421.

8874 (SZS-157, pp 2-5) RADIATION HYGIENE (BASIC PRINCIPLES, THEORY, AND PRACTICE). Ramzaev, P. V.; Poplavskii, K. K. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

Contemporary health physics consists of three interrelated components: dosimetry, radiobiology, and shielding. The basic principles, theory, and usual practices in each of these areas as well as the current work being done in these areas are summarized. The goal of health physicists is to control the conditions for work with radiation sources, monitoring of the radiation burden of the workers, and organization and development of methods for dealing with wide-spread dissemination of radioactivity. Each of these aspects is briefly discussed. (JSR)

8875 (SZS-157, pp 42-45) RADIATION HYGIENE EVALUATION OF RADIATION EFFECTS ON THE POPULATION DURING X-RADIOLOGICAL STUDIES. Kudritskii, Yu. K.; Serebryannikov, V. D.; Zakharenko, Yu. S.; Il'ina, K. P.; Koroleva, T. M.; Kuznetsov, A. I.; Lisenkova, L. N.; Rabinovich, Ya. L. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

A method was developed for the determination of the size of the mean gonad dose and the genetically significant dose (MGD and GSD) during x-radiological studies. The method is based on introduction of a coefficient of proportionality between the frequency and the average size of the MGD and GSD for each type of radiological procedure. The indices calculated for evaluation of the radiation effects on the population were tabulated for the USSR, the Russian Soviet Federated Socialist Republic, and the cities of Leningrad and Moscow. From observations made on patients a dependence was established between fluorographic examination of pregnant women at various weeks of development of the fetus and the weight and height of the new-born child. It was concluded that radiation effects during radiological examination causes not only reactions but some changes in the state of health. (JSR)

8876 (SZS-157, 187-190) RADIOLOGICAL PROTECTION METHODS IN CONNECTION WITH THE DEVELOPMENT OF ATOMIC ENERGY. Vlodek, S. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The concept of maximum permissible activity is defined and discussed. Methods for its calculation are summarized. The primary arguments used by those opposed to the development of nuclear power plants are given. (JSR)

8877 (TID-26642) JOINT RADIATION SURVEY SUMMARY, 1968. Gileadi, M. (Commonwealth of Puerto Rico Dept. of Health, San Juan; Puerto Rico Nuclear Center, San Juan). 1974. 324p. Dep. NTIS $19.25.

A joint survey was conducted by the Department of Health of the Commonwealth of Puerto Rico and the Puerto Rico Nuclear Center to evaluate the magnitude and frequency of health hazards incurred by patients undergoing diagnostic x-ray examinations. The significance of ^{40}K, U, and Th in the natural background radiation is considered. Effects and sources of ionizing radiation are discussed. Hazards due to gonad irradiation associated with diagnostic x-ray procedures were evaluated. Radiodiagnostic procedures for abdominal and chest examinations are listed. The work of the survey was carried out in the following phases: collection of data, statistical study of data, dosimetric study, and evaluation of quantifiers based on dosimetry, demography, and statistics in order to compare radiation protection in Puerto Rico with that of other countries. Results are tabulated and discussed. (HLW)

8878 (UCLA-12-966, pp 113-139) MEDICAL APPLICATIONS OF RADIATION MEASUREMENTS. 1974.

In annual progress report for the period ending June 30, 1974.

Progress is reported on the following research projects: computerized x- or gamma ray transmission tomography for organ scanning application; positron emitter; new materials for semiconductor radiation detectors; development of a proton and/or heavier ion microprobe for biological application; and in vivo radiation detection probes for use in plutonium lymph node assay and potential early diagnosis of lung tumors. (HLW)

8879 APPROXIMATE CALCULATION OF THE RISKS FROM ^{14}C PRODUCED IN NUCLEAR EXPLOSIONS. Romero, C.; Toha C., J. (Universidad de Chile, Santiago). Cienc. Interamer.; 14: No. 3-6, 10(1973). (In Spanish).

The mutations that can be attributed to the presence of ^{14}C in the atmosphere as a result of nuclear explosions are calculated approximately. The calculations show that the mutation rate induced by ^{14}C will equal that occurring naturally in the next 100 years and that therefore the mutation rate will be doubled. (JSR)

8880 OSMOTIC RESISTANCE OF LEUKOCYTES OF THE PERIPHERAL BLOOD IN PATIENTS WITH CANCER OF THE UTERUS DURING COMBINED RADIATION THERAPY. Yakimova, T. P.; Burshtein, Sh. A.; Markova, O. P. (Kharkov Scientific Research Inst. of Medical Radiology). Lab. Delo; No. 4, 454-456 (1972). (In Russian).

The osmotic resistance of the leukocytes was determined in 74 patients with cancer of the cervix and in 18 patients with cancer of the uterus. The patients were irradiated with a combined radium and external x-ray or γ radiotherapy. Twelve of the patients also received chemotherapy. The results showed that both the total quantity of leukocytes and their osmotic resistance were reduced. The reduction of the osmotic resistance preceded the development of leukopenia. (JSR)

8881 LUNG CANCER AMONG ATOMIC-BOMB SURVIVORS STUDY OF 114 AUTOPSY CASES, 1957–72. Hamada, T.; Ishida, S. (Hiroshima Atomic Bomb Hospital). Hiroshima Igaku; 27: No. 6, 558-569(Jun 1974). (In Japanese).

Lung cancer was epidemiologically studied in 114 autopsy cases in Atomic Bomb Hospital, Hiroshima. The frequency of the cancer was examined in the relation with the distance from the hypocenter at time of bomb, year, age, sex, residential area, histological type, complication rate of lung tuberculosis, acute sign and the length of stay in the city shortly after the exposure of atomic-bomb and smoking, as listed in the tables. Macroscopical and electron microscopical features of lung cancer were presented, and the metastasis to each organ at autopsy and the cases with duplicated cancer were reviewed. (JA)

8882 ACTUAL STATE OF THE NEW MASS EXAMINATION WITH CONSIDERATION OF EXPOSURE TO THE GONADS IN THE INFANTS WITH CONGENITAL DISLOCATION OF THE HIP JOINT. Shinohara, H. (Matsudo City Hospital, Chiba, Japan); Tsuchiya, K.; Kanno, Y.; Tanaka, H. Rinsho Seikei Geka; 9: No. 3, 203-211 (Mar 1974). (In Japanese).

X-ray diagnosis is mostly effective for the examination in the infants with congenital dislocation of the hip joint. However, there was a problem on the exposure to the gonads. The way exposure dose could be decreased in the mass examination was studied. When the infants were roentgenographed with standard screen FS and the gonadal dose was assumed as 1, it became possible to decrease the exposure dose to the ratio of 1/100 without selective roentgenographic examination by thoughtful consideration of the exposure. In addition, when the selective roentgenographic examination was done, the exposure dose showed a decrease to about 1/400 compared with the previous method, in mass examination. We have used the latter method now. In addition, new apparatus will be used in practice. When this apparatus is used, the dose of exposure to the gonads can be decreased to 1/1600 in the selective roentgenographic examination without protection and to 1/16000 by using the protective device. The problem on x-ray examination to the mass should be furthermore discussed. (JA)

8883 COMBINED RADIOLOGIC/OPERATIVE THERAPY IN THE TREATMENT OF CERVICAL MALIGNANCY. Stage, A. H.; Crawford, E. J.; Robinson, L. S.; Brooks, G. G. (Louisiana State Univ., Baton Rouge). Thin Solid Films; 120: No. 7, 960-968(1 Dec 1974).

In an attempt to increase survival in cervical malignancies, a study was started in 1950 with preoperative internal and external irradiation followed by radical operation. The study was made at Confederate Memorial Medical Center in Shreveport, Louisiana. Three previous reports seemed to indicate an advantage to this combined approach. Current findings since the preliminary results were reported are presented. (auth)

8884 BASIC PRINCIPLES IN THE EVALUATION OF THE RADIATION SITUATION IN URANIUM MINES. Shalaev, I. L.; Bykhovskii, A. V.; Saltykov, L. D.; Pavlov, I. V.; Komodov, A. A.; Shishkin, V. I. Gig. Sanit.; No. 10, 41-46(Oct 1974). (In Russian).

The possible levels of different radiation danger factors during the underground development of U mines were examined. It was shown that the radiation situation is basically determined by the size of the latent energy of daughter products of radon in the mine atmosphere. The optimum body of data on the radiation situation is enumerated. This makes it possible to determine the degree of radiation dangers of present work conditions and the necessary complex of protective measures. (tr-auth)

8885 BASIC ISSUES AND UNSOLVED PROBLEMS IN THE FIELD OF HEALTH PHYSICS. Lyarskii, P. P.; Moiseitsev, P. I. (Scientific-Research Inst. of Labor and Professional Hygiene, Moscow). Gig. Sanit.; No. 10, 52-54(Oct 1974). (In Russian).

The basic issues and unsolved problems in the field of health physics involve at present professional radiation pathology, radiobiology, dosimetry, and shielding. These are briefly discussed. (JSR)

8886 ENVIRONMENTAL ASPECTS AND SAFETY IN THE USE OF NUCLEAR ENERGY. Alonso Santos, A. Energ. Nucl. (Madrid); 18: No. 89, 137-155(1974). (In Spanish).

A brief summary is made of methods of producing abundant nuclear energy without endangering the health and safety of the population and without prohibitive energy costs. The effects of radiation are first outlined. The most common fuel cycles are discussed. Methods for the disposal of radioactive wastes with special consideration of tritium and krypton are considered. The dangers in the case of accident are outlined. The concept of defense in depth is defined. The problem of solid radioactive wastes is discussed. (JSR)

8887 EFFECT OF IRRADIATION WITH PROTONS OF 50 MeV ON THE AMOUNT OF CHROMOSOME ABERRATIONS IN LYMPHOCYTES FROM HUMAN PERIPHERAL BLOOD. Todorov, S.; Mileva, M.; Ivanov, B.; Bulanova, M. (Nauchno-Izsledovatelski Inst. po Radiologiya i Radiatsionna Khigiena, Sofia (Bulgaria)). Eksp. Med. Morfol.; 11: 220-226(1972). (In Bulgarian).

Irradiation of lymphocytes from human peripheral blood with absorbed doses of 25, 50, 100, 250, and 500 rads of 50 MeV protons result in various chromosome aberrations such as chromosome fragments, interstitial deletions, dicentrics, rings. From this data, cells with structural aberrations, the total number of aberrations, and the total number of ruptures were calculated. The statistical elaboration of the experimental data after the method of the least squares yields curves of regression for various chromosome disturbances, described by the mathematical models—$y = bD^n$ and $y = a + vD$. Comparative analysis of data on the amount of chromosome aberrations after irradiation with 50 MeV protons and 180 kV x rays shows RBE coefficients of 1.01 for cells with structural aberrations and 1.17 for chromosome fragments. (auth)

8888 MYELOFIBROSIS AMONG ATOMIC-BOMB SURVIVORS REPORT OF TWO AUTOPSY CASES. Sasaki, M. (Hiroshima Red Cross Hospital); Hamada, T.; Ishida, S. Hiroshima Igaku; 27: No. 6, 545-554(Jun 1974). (In Japanese).

The present study summarizes the autopsy findings in two cases each with primary myelofibrosis and myelofibrosis secondary to leukemia. A 51 year old man was directly exposed at a distance of 900 m from the hypocenter at time of the bomb in Hiroshima city and primary myelofibrosis was induced 27 years after the explosion. A 57 year old man, who was directly exposed at a distance of 1,400 m from there, suffered from chronic myelocytic leukemia after 10 years and myelofibrosis after 27 years. The former died in the following year and the latter died during the year. In both cases, peripheral blood pictures, patho-anatomical diagnoses, and histological findings were examined to observe pathological change. (JA)

8889 EXPOSURE OF PATIENTS IN AXIAL TRANSVERSE TOMOGRAPHY. Maekoshi, H.; Koga, S. (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 2, 108-115(Feb 1974). (In Japanese).

In axial transverse tomography for pelvis, radiation doses of the skin, gonad, and volume dose of a patient were measured and were compared with those in conventional radiography for the same part of the body. Exposure conditions of axial transverse tomography for the pelvis were 120 kV (of the tube voltage), 25 mA (of the tube current), 15 sec (of exposure time), and 212.8 cm of the distance between the tube focus and the rotation center of tomograph for adults, and 110 kV, 5 mA, 15 sec, and 212.8 cm, respectively, for five-year-old children. The distance between the rotation center and the film was 50.5 cm. In order to control the field size during axial transverse tomography, the compensating filter (16 mm Al + 0.4 mm Cu) was installed at the top of the radiation cone. In conventional radiography for the pelvis, the exposure conditions were 65 kV, 100 mAs, 100 cm of the source-film distance, and 30 × 30 cm of the field size for adults, and 65 kV, 20 mAs, 100 cm, and 22 × 22 cm, respectively, for children. Absorbed dose in Mix Dp phantom of the pelvis was measured with the thermoluminescent dosimeter ($Mg_2SiO_4 : Tb$). The volume dose for adults from conventional radiography was 2580 g.rad, that from axial transverse tomography with the compensating filter was 2230 g.rad, and that from axial transverse tomography without the compensating filter was 2770 g.rad. The gonad dose for adult female from axial transverse tomography was about 1.4 times larger than that from conventional radiography and that for female child from axial transverse tomography was about 2.3 times larger than that from conventional radiography. (auth)

8890 COMPARISON OF THE PRIMARY STANDARD OF THE EXPOSURE UNIT FOR γ-RADIATION OF ASMW (GDR) AND WNIIN (USSR). Kunze, R. (Fachabteilung Ionisierende Strahlung, Berlin); Rothe, H.; Judin, M. F.; Ostromuchova, G. P. Isotopenpraxis; 10: No. 9, 321-325(Sep 1974). In German).

An international comparison of the primary standard of the exposure unit for high-energy quantum radiation performed by central metrological establishments of the USSR and the GRD is reported. The arrangement of the two standard metering devices is described. The reference measurement performed on ^{60}Co γ sources yielded a maximum difference between the two standards for unit plotting of 0.8%. (auth)

8891 MERITS OF DEVELOPING NEW TECHNOLOGY FOR MEDICAL APPLICATIONS. Potchen, E. J. (John Hopkins Univ., Baltimore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 2, 3-14(Apr 1974).

Problems concerning communication between medicine and engineering are reviewed. Some topics discussed are management research; the use of diagnostic x rays in defensive medicine; the use of radiology as an information system in patient management; cost of diagnostic x rays; interrelationship of medical and legal factors in patient care; computer models of information flow defining the diagnostic process; and the use of nuclear medicine procedures. (HLW)

8892 PROBLEMS ON THE EFFECT OF FAINT RADIATION. Doke, T. (Waseda Univ., Tokyo). Kagaku (Tokyo); 44: No. 5, 308-313(May 1974). (In Japanese).

This paper describes the effect of long-term exposure of human body to low-dose radiation. Although exposure dose was measured in Kerala, the west seaside of India with a great amount of natural radiation, no significant findings on the effect of faint radiation on human body were obtained from these statistical investigations. Therefore, the incidence of leukemia and the relationship between the exposure in fetus within mother's body and infant cancer were studied on the basis of the survey report on exposures in Hiroshima and Nagasaki. Synergistic effects of radiation and other carcinostatic factors (ethionine, smoking etc.), and the relationship between the dose and effect were also examined. (JA)

8893 INFLUENCE OF DOSE DISTRIBUTIONS BY TIME ON THE RESULTS OF TELEGAMMA THERAPY OF MALIGNANT TUMORS OF THE LARYNX. Borisevich, N. V.; Baimakanova, S. Sh.; Zholkiver, K. I.; Rakhmetova, A. U. (Kazakh Scientific-Research Inst. of Oncology and Radiology, USSR). Med. Radiol.; 19: No. 12, 6-13(Dec 1974). (In Russian).

Results of tele-gamma-therapy of 249 patients suffering from larynx cancer following different modes of dose fractionation were analyzed. The patients were divided into 4 groups: small fractionation (continuous course of treatment) 200 to 250 rad 5 to 6 times a week (56 patients); medium fractionation (continuous course of treatment) 350 to 400 rad three times a week (55 patients); small fractionation with a split course of treatment (112 patients); and medium fractionation with a split course (26 patients). The mode of dose fractionation did not considerably influence the immediate results of treatment. The best statistically reliable remote results were obtained after small dose fractionation. A 5-year recovery after continuous irradiation was observed in 53.7 ± 7.2% in medium fractionation; after a split course in 75.0 + 12.5% (small fractionation); and in 12.5 ± 11.7% (medium fractionation of the dose). In small fractionation, radiation reactions were less marked and developed later than in cases of medium fractionation. It was also established that regardless of the kind of fractionation, the corresponding radiation reactions developed with the adequate value of nominal standard dose. (auth)

8894 MOVING-FIELD GAMMA-THERAPY OF CERVIX UTERI CANCER. Abakov, B. M.; Zholkiver, K. I.; Musapirova, N. A.; Kim, O. M. (Kazakh Scientific-Research Inst. of Oncology and Radiology, USSR). Med. Radiol.; 19: No. 12, 16-22(Dec 1974). (In Russian).

Results are reported of treatment of two equivalent groups (each having 150 patients with cervix uteri cancer). In the first group a combined radiation treatment was applied, in the second one, a moving-field gamma-therapy method was used. In 94 per cent of the patients from each group the IInd and IIIrd stages of the disease were diagnosed. A three year survival was obtained in 64.6 ± 4% after a combined radiation treatment and in 62.4 ± 4% after a moving-field gamma-therapy. Late radiation complications developed in 31.3% of patients from the first group and in 30.6% from the second one. Complications had a milder form and were more amenable to treatment in those patients who had undergone mobile gamma-therapy. The patients of this group had no radiation reactions in the skin. Relapses after a combined radiation treatment developed in 36 patients, and after a mobile treatment in 46 patients (in 38 of them, at the site of the primary tumor). (auth)

8895 RESULTS OF TREATMENT AND OUTCOMES OF POLYCYTHEMIA VERA. Belugina, Z. T. (Central Scientific-Research Rentgeno-Radiological Inst., Moscow). Med. Radiol.; 19: No. 12, 22-27(Dec 1974). (In Russian).

A total of 170 patients with polycythemia vera of the second degree in a period of 25 years underwent 464 courses of radiation and chemotherapy. The best results were obtained after treatment with ^{32}P, in combination with irradiation of the cervical sympathetic ganglions. The main causes of death were cardiac and vascular affections (36.4%) and hematological transformations of polycythemia (29.5%). An average life span in the group of the deceased was 11 years. Those patients who died of cardiac and vascular disorders had lived as an average for 11.2 years, those who died of leukemia 10 years, and of myelofibrosis and myeloid metaplasia 17.8 years. Development of leukemia in some patients was associated apparently with a high irradiation dose. A plan of treating polycythemia in its different phases is presented. (auth)

8896 LESSENING OF THE LEVEL OF IRRADIATION OF THE GONAD REGION IN ROENTGENOLOGICAL INVESTIGATION OF THE THORAX IN CHILDREN. Maktaz, I. P.; Gordon, V. I.; Gubatova, D. Ya.; Pavlova, T. G.; Rabinovich, F. N.; Balode, G. Yu. Vestn. Rentgenol. Radiol.; No. 5, 79-80(1974). (In Russian).

The results of phantom studies using LiF detectors indicate that circular shielding of the gonad region with a Pb equivalent of 0.3 mm during x-radiological studies of the thorax in children appears to be an effective means for reducing the gonad dose for all presently used values of the x-ray tube voltages. (JSR)

Vertebrates

Refer also to abstracts 8810 and 8840.

8897 (AD-783023) GRAFT VERSUS HOST DISEASE IN RATS AFTER DONOR TREATMENT WITH CYCLOPHOSPHAMIDE AND SPLEEN CELLS OF HOST ORIGIN. Fink, M. P.; Cloud, C. L.; Exum, E. D. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Apr 1974. 20p. (AFRRI-SR-74-4). NTIS $3.00.

Lethally irradiated Lewis-Brown Norway F1 hybrid (LBN) rats were grafted with either marrow or marrow and spleen cells from normal Lewis (L) donors. All recipients of inocula containing both marrow and spleen cells died of graft versus host (GVH) disease. In other irradiated and grafted rats, the severity of the GVH disease was reduced by challenge of the donor with DBN spleen cells prior to or after treatment with cyclophosphamide (CY). The magnitude of this suppressed immunity depended on the interval between the administration of CY and the allogenic spleen cells. Maximum suppression was obtained when donors received CY on day 0 and LBN cells on day +1. In all experiments, the treated donors were sacrificed on day +7. The observed immunosuppression was shown to result from the synergistic action of CY and cells bearing the alloantigens of the recipient. Furthermore, the phenomenon was demonstrated to be antigen specific. (auth)

8898 (AD-783794) RADIATION INDUCED CHANGES IN INTRACRANIAL PRESSURE AND ARTERIAL BLOOD PRESSURE. Final Report. Watters, J. W.; Wailly, L. F.; Carter, P. B. (Air Force Academy, Colo. (USA)). Jun 1974. 27p. (USAFA-TR-74-13). NTIS $3.25.

Twenty Macaca mulatta monkeys were exposed to cobalt-60 gamma radiation at the rate of 1000 rad/min for mid-thoracic doses of approximately 1307 rad to 10 monkeys and 2244 rad to the remaining 10 animals. The average intracranial pressure increased in both groups following exposure, but the response observed in the low-dose group was not so great as that elicited in the monkeys that were exposed to higher levels of irradiation. Hypotension developed in the majority of animals postirradiation, and the degree of response was greatest in the high-dose group of monkeys. (auth)

8899 (BNL-19248) RADIOSENSITIVITY OF ANTIBODY RESPONSES AND RADIORESISTANT SECONDARY TETANUS ANTITOXIN RESPONSES. Stoner, R.; Terres, G.; Cottier, H.; Hess, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 31p. (CONF-740930-6). Dep. NTIS $4.75.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

Primary tetanus antitoxin responses were increasingly repressed in mice when γ-radiation doses of 100 to 400 rads were delivered by whole-body exposure prior to immunization with fluid tetanus toxoid (FTT). Primary responses were about 3 times more radiosensitive than secondary responses when both responses were elicited with FTT. The highly radiosensitive nature of primary responses was not observed, however, when animals were immunized with antigen-antibody complexes formed in vitro with FTT and specific mouse tetanus antitoxin. Radiation doses of the order needed to repress secondary responses were required to inhibit primary responses to completed FTT formed in equivalence and/or antigen excess. Nearly normal secondary antitoxin responses were obtained in mice exposed to 600 rads of γ-radiation 4 days after secondary antigenic stimulation with FTT. A rapid transition from radiosensitivity of the antibody-forming system on days 1 to 3 was followed by relative radioresistance on day 4 after the booster injection of toxoid. Studies on lymphoid cellular kinetics in popliteal lymph nodes after injection of ^{3}H-thymidine and incorporation of ^{3}H-L-histidine into circulating antitoxin were carried out. Analysis of tritium radioactivity in antigen-antibody precipitates of sera 2 hours after injection of the labeled amino acid revealed maximum incorporation into antibody around day 7 after the booster in non-irradiated controls and about day 12, i.e., 8 days post-radiation, in experimental mice. The shift from radiosensitivity to relative radioresistance was attributed to a marked peak of plasmacellular proliferation in the medulla of lymph nodes on day 3. Many medullary plasma cells survived and continued to proliferate after exposure to radiation. Germinal centers were destroyed by radiation within 1 day. Since antibody formation continued after exposure to radiation and after the loss of germinal centers, this supports the view that germinal center cells were involved more in the generation of memory cells than in antibody synthesis. (auth)

8900 (SZS-157, pp 68-70) APPEARANCE OF LUNG TUMORS IN MICE EXPOSED TO THE COMBINED EFFECTS OF CARBON BLACK INHALATION AND EXTERNAL PHOTON RADIATION. Shchagin, Yu. A.; Knizhnikov, V. A.; Styazhkikh, V. M. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The chronic inhalation of carbon black causes the appearance of lung tumors in 13 of the experimental animals. In the animals exposed to whole-body photon irradiation for 31 days for a total dose of 930 R, lung tumors appeared in 5 of the animals. The combined effect of inhalation of carbon black and whole-body photon radiation led to the appearance of lung tumors in 22 of the experimental animals. The damaging effects of carbon black and irradiation appears therefore to be cumulative. (JSR)

8901 (SZS-157, pp 75-78) EFFECT OF Ca AND F, AS DIET COMPONENTS, ON THE RADIORESISTANCE OF WHITE RATS. Knizhnikov, V. A.; Grozovskaya, V. A.; Luzanov, V. M. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

Rats receiving in their diet increased concentrations of Ca and F have a much higher radioresistance to whole-body γ radiation. The protective effect from the addition of Ca to food and F to the water was shown both with insufficient levels of these elements in the diet and with levels close to physiological optimum. The maximum value of the protective effect was observed during diets enriched with relatively low original levels of Ca and F. The increase of the radioresistance as a result of Ca addition to the food and F addition to the water was very clear at irradiation doses up to LD 50/30. At doses above LD 70/30 an increase of the concentration of Ca and F in the diet was not reflected in the radioresistance of the animals. An increase of the Ca and F in the diet not only increased the survival of the animals in the first 30 days after irradiation but also prolonged their lives. (tr-auth)

8902 (SZS-157, pp 89-92) REGULARITIES IN THE CYTOGENETIC EFFECTS OF LOW DOSES OF IONIZING RADIATION. Kudritskii, Yu. K.; Bikkulov, R. I.; Grigor'eva, L. P.; Kuznetsov, A. I.; Lisennova, L. N.; Rabinovich, Ya. L. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The results of studies of the cytogenetic effect of low doses of ionizing radiation, made both on humans and mice, are reported in tabular form and discussed. The dependence of the frequency of chromosome aberration on the γ background level of the habitation, the age dependence of the spontaneous level of cytogenetic changes, age dependence of the change in the frequency of chromosome aberrations after local irradiation during x-radiological diagnosis of the stomach, dependence of the frequency of chromosome rearrangement on the age of mice and the daily dose rate, and the dependence between the exposure dose and the frequency of cytogenetic changes in lymphocytes of the peripheral blood in patients during x-radiological examination of the stomach and chest organs were the factors discussed. (JSR)

8903 (UCSF-10P2-244) COMPARISON OF SURVIVAL CURVES FOR THE EMT6 TUMOR IRRADIATED IN VITRO, IN VIVO AS MACRO-COLONIES IN THE LUNG, AND IN VIVO AS LARGE FLANK TUMORS. Fu, K. K.; Phillips, T. L.; Wharam, M. D. Jr.; Kane, L. J. (California Univ., San Francisco (USA)). 1974. 17p. (CONF-740960-1). Dep. NTIS $4.00.

From 6th L. H. Gray conference on initial shapes of cell survival curves; clinical and theoretical implications; London, UK (16 Sep 1974).

The response of the mouse mammary EMT6 tumor to radiation was studied under various growth and irradiation conditions. Cells grown and irradiated in vivo as large flank tumors were least radio-sensitive and had the largest shoulder on the survival curve. Cells grown in cell culture and irradiated in vitro were most radio-sensitive and had the smallest shoulder, and cells grown in flank tumors but irradiated in vitro had an intermediate radio-sensitivity and shoulder. Cells grown and irradiated as small lung nodules were more radio-sensitive than large flank tumors and exhibited a smaller shoulder. With continuous irradiation at low dose rates, the extrapolation number ($\bar{n}$) was found to decrease and the D_0 to increase with decreasing dose rate. (auth)

8904 MUTAGENIC AND CYTOTOXIC PROPERTIES OF IRRADIATED FOOD PRODUCTS. Bronnikova, I. A.; Okuneva, L. A. (Moscow Scientific-Research Inst. for Food). Vop. Pitan.; 32: 46-50(1973). (In Russian).

A complementary investigation of irradiated foodstuffs earlier permitted for consumption was made for the presence of a potential mutagenic and cytotoxic effect thereof on the organism. An experimental ration was made up, whose vegetable portion consisted in 82.2 percent by calorific value of irradiated products allowed for alimentary purposes. To inquire into the cytogenic action by using a test for recording chromosomal aberrations of the bone marrow an experiment was conducted on 32 mice of radiosensitive lines BHLB/e and C_{57} in which, following a seven-day long feeding on the ration in question, a total of 1600 metaphasic plates were analyzed. The results of the research into the cytotoxic action of irradiated products showed the absence of any marked untoward effect of the experimental ration, whose composition included irradiated products allowed for human consumption. (auth)

8905 INFLUENCE OF CYSTAMINE ON THE COLONY-FORMING ABILITY OF BONE MARROW CELLS OF IRRADIATED GUINEA PIGS IN A MONOLAYER CULTURE. Dzharak'yan, T. K.; Akopova, A. A.; Berlin, L. B.; Gusev, I. V.; Kutasova, N. V. (Military Medical Academy, Leningrad). Dokl. Biol. Sci.; 215: No. 1-6, 117-119(1974).

Translated from Dokl. Akad. Nauk SSSR; 215: No. 4, 1007-1009 (Apr 1974).

The state of the proliferative potentials of the bone marrow after irradiation and the influence of cystamine on them were determined. Male guinea pigs were γ-irradiated at a dose of 400R following which some received cystamine intraperitoneally. The influence of cystamine was determined by the number and size of bone marrow colonies formed after 14 days of culturing. It was determined that cystamine had a positive influence both on colony-forming ability and on colony size. (ERB)

8906 MEPRIN, A NEW RADIATION PROTECTION AGENT. Santha, A.; Mandi, E.; Benko, G. Honvedorvos; 26: No. 2, 145-149 (1974). (In Hungarian).

The sulfhydryl derivative "Meprin" was shown to have good radiation-protective properties without exhibiting toxicity. The Japanese literature shows this product to be an effective drug in hepatitis, metal poisoning, allergies, and leucopenias. Experimental work showed Meprin to have anti-radiation properties when given before or after irradiation and to be better than any known agents for treating radiation sickness. Further study should be made of this product. (tr-auth)

8907 REPAIR OF DNA IN MAMMALIAN CELLS. Strauss, B. S. (Univ. of Chicago). Life Sci.; 15: No. 10, 1685-1693 (15 Nov 1974).

The subject is briefly reviewed under the following headings: lesions in DNA; bacterial repair; excision repair in mammalian cells; post replication repair; and repair, carcinogenesis, and mutation. (ERB)

8908 RADIOPROTECTIVE EFFECT (UV AND GAMMA) OF TRYPTOPHANE AND A MOLECULAR MODEL BASED ON THE INTERACTION OF TRYPTOPHANE WITH THE NADH MOLECULE. Grez, M.; Gutierrez, M.; Palma, T.; Toha C., J.; Winckler, C. (Universidad de Chile, Santiago). Cienc. Interamer.; 14: No. 3-6, 7-10(1973). (In Spanish).

The high sensitivity of rabbit erythrocytes to both uv and γ radiation and the protective effects of tryptophane in N_2, O_2, N_2O, and air atmospheres were reported previously. On the basis of these data and the known interaction of tryptophane with NADH, an attempt is made to construct models for the interpretation of the protective effects of tryptophane in the various atmospheres. (JSR)

8909 TUMOR COLONY GROWTH IN THE IRRADIATED MOUSE LUNG. Thompson, S. C. (Saint Bartholomew's Hospital, London). Brit. J. Cancer; 30: No. 4, 337-341(Oct 1974).

The effect of irradiation of recipient mouse lung on tumor colony growth after intravenous injection of C3H mammary adenocarcinoma cells or aggregates was tested in C3H male mice irradiated with 14-MeV electrons to the whole or half of the thorax. Injections were made 3 h, 48 h, 3½ months, or 9½ months after irradiation. The number and size of colonies were increased in irradiated areas of the lung at 48 h and at 3½ months after doses of 2000 rad. However, 9½ months after irradiation lungs were found to be atrophied and fibrotic and enumeration of tumor colonies was found to be impossible. An increase in colony growth after 250 rad was seen only at 9½ months after irradiation. (auth)

8910 INCIDENCE OF LUNG METASTASES IN C^3H MICE AFTER TREATMENT OF IMPLANTED SOLID TUMORS WITH X-RAYS OR SURGERY. Sheldon, P. W.; Begg, A. C.; Fowler, J. F.; Lansley, I. F. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Cancer; 30: No. 4, 342-348(Oct 1974).

C3H mice were implanted with pieces of spontaneous mammary carcinoma, which were irradiated or removed surgically when they had grown to 6.5 mm mean diameter. The incidence of lung metastases was determined from samples taken at various times up to 6 months later. Single x-ray doses and fractionated schedules up to 15 fractions in 18 days were used, no significant difference being observed in the results for all these schedules. On the major question of whether radiation caused an increase in the number of lung metastases the study was inconclusive. The incidence of metastases was found to be 8% if the implanted tumor was cured by the radiation, whereas if the radiotherapy did not cure the tumors the incidence was 35%. This difference between the two groups was significant. If tumors recurred locally after radiotherapy and were then removed surgically, the incidence of lung metastases was significantly greater than that after surgery of unirradiated tumors. The incidence of metastases was similar after curative surgery and after curative radiotherapy. (auth)

8911 RELEASE OF THROMBOGENIC FACTORS BY X RAYS. Wegrzynowicz, Z.; Wronowski, T.; Latallo, Z. S.; Kopec, M. (Inst. of Nuclear Research, Warsaw). Arch. Immunol. Ther. Exp.; 22: No. 5, 689-694(1974).

Neutralization of heparin in vitro by plasma obtained from irradiated rabbit (whole body, 900 R, x rays), as well as a sharp decrease in the anticlotting effect of heparin in vivo after exposure to the same dose of radiation were observed. Evidence is presented that material endowed with antiheparin activity and with ability to precipitate fibrin from its soluble complexes is released from calf thymocyte suspensions in saline when exposed to x rays. A linear dose-effect relationship was found in the range from 0 to 5000 R. (auth)

8912 ANTIGENICITY OF MURINE SKIN TUMORS INDUCED BY ULTRAVIOLET LIGHT. Kripke, M. L. (Univ. of Utah, Salt Lake City). J. Nat. Cancer Inst.; 53: No. 5, 1333-1336(Nov 1974).

Murine skin tumors induced by chronic treatment with ultraviolet (uv) light exhibited an unexpectedly high degree of antigenicity compared with tumors induced by chemical carcinogens. Uv-induced spindle cell tumors completely regressed when transferred to normal syngeneic recipients and grew progressively only in immunosuppressed hosts. Squamous cell carcinomas produced by uv light also showed this unusual behavior, but to a lesser extent. No cross-reactivity was detected among these tumors by in vivo cross-protection tests. (auth)

8913 STUDIES ON PANCREATIC RADIOSENSITIVITY. Bozduganov, A.; Tileva, M. (Vissh Meditsinski Inst., Plovdiv (Bulgaria)). Rentgenol. Radiol.; 12: No. 1, 22-25(1973). (In Bulgarian).

Results are reported of two experiments carried out on 120 mice, with the purpose of studying pancreatic radiosensitivity. The first experiment was performed on 60 mice exposed to chronic irradiation with a total dose of 5000 r and a dose rate of 31.6 r/hour. The radiation-induced morphologic changes in the pancreas were mild. The second experiment was carried out on 60 mice: 30 of these were exposed to a daily dose of 50 r at a dose rate of 232 r/min for a period of 32 days. The other group of 30 mice was exposed to a daily dose of 10 r at a dose rate of 7.1 r/min also for 32 days. No particular morphologic changes were demonstrable in the Langerhans islet cells and the acinose cells. Using autoradiographic techniques and double labelling generation time, the EC-phase duration, and the mitotic and ^{3}H-indexes were determined. The data were processed by Fisher-Student's variation-statistical method. There were no statistically significant differences, in spite of the marked tendency toward decrease in the index of strongly labelled cells in irradiated animals and the increased duration of the generation time. Inferences are drawn about pancreatic radioresistance to chronic irradiation. (auth)

8914 ELECTROPHORETIC STUDIES ON PROTEINS OF TAIL OF HOUSE LIZARD. Pushpendran, C. K.; Eapen, J. (BARC, Bombay). J. Anim. Morphol. Physiol.; 19: No. 2, 191-195(1972).

Effect of temperature acclimation, x irradiation, amputation and regeneration, and colchicine treatment on tail proteins of a house lizard, Hemidactylus leschenaulti, has been studied using gel disc electrophoresis. There are qualitative differences in tail proteins of lizards acclimated to 24° and 37°. X irradiation seems to affect the tail proteins of lizards acclimated to 24°. Treatment with colchicine modifies the electrophoretic pattern of proteins. The widest variations of proteins were found in the regenerated tail. (Indian Sci. Abstr.)

8915 DIFFERENTIATION OF IMMUNOLOGICALLY SPECIFIC CYTOTOXIC MACROPHAGES INTO TWO TYPES ON THE BASIS OF RADIOSENSITIVITY. den Otter, W.; Evans, R.; Alexander, P. (Chester Beatty Research Inst., Sutton, Eng.). Transplantation; 18: No. 5, 421-428(Nov 1974).

Macrophages which are cytotoxic in vitro to tumor cells in an immunologically specific manner can be classified into (1) radiosensitive, cytotoxicity totally abolished by 500 R of x rays; and (2) radioresistant, cytotoxicity unaffected by 500 R but partially ablated by 1,000 R. Radiosensitive macrophages are found in both syngeneic and allogeneic mice immunized with radiation-killed lymphoma cells. Radioresistant macrophages are produced by immunizing mice with allogeneic living lymphoma cells. In a syngeneic system radioresistant macrophages are produced when mice, which have first been rendered immune by immunization with radiation-killed cells, have rejected an inoculation of living cells. Immune or armed macrophages which have been rendered nonspecifically cytotoxic (i.e., activated by incubation with the antigen to which they are sensitized) or normal macrophages activated by treatment with endotoxin show very great resistance to irradiation and retain activity after exposure to 5,000 R in vitro. (auth)

8916 SUPPRESSION BY DRUGS AND X-RAY OF THE IMMUNE RESPONSE OF MICE TO MALIGNANT LYMPHOCYTES. Martinez, D. Ann Arbor, MI; Univ. of Michigan (1974). 71p. University Microfilms Order No. 74-25,264.

Thesis (Ph. D.).

The immunosuppressive effects of cyclophosphamide (CY), methotrexate (MTX), prednisolone (PRD), and x-irradiation (XR) on both the first- and second-set immune reactions to syngeneic malignant lymphoid cells (line I_b leukemia) were examined in detail. The maximum tolerated dose (LD10) of each agent was determined to provide a uniform measure of immunosuppressive activity. A first-set reaction was defined as the ability of normal C58 mice to withstand injection of 10^7 formalin-treated I_b cells (containing ca 10^3 viable leukemic cells). The first-set reaction was suppressed when mice were given an LD10 of any agent 24 hr before formalinized I_b cells, i.e., mice died from the leukemic cells contained in the preparation. When the agents were given 24 hr after I_b cells they were less immunosuppressive. For example, the immunosuppressive effect of CY ($^1/_8$ LD 10) decreased the later it was given (1 to 7 days) after I_b cells were injected. To assess the fate of viable I_b cells contained in formalinized cell preparations when injected into normal and CY-immunosuppressed mice, spleens were assayed for I_b cells over a 20 day period. In normal mice I_b cells proliferated in the spleen for 6 days, then they were immunologically rejected. In mice given CY (LD10) 24 hr before formalinized I_b cells it was found that the viable I_b cells continued to proliferate after day 6, i.e., the cellular immune response was suppressed. The relative immunosuppressive efficacy of the agents was evaluated for first- and second-set immune reactions by determining the median immunosuppressive dose, median recovery time, and median lethal dose of I_b cells. The median immunosuppressive dose of an agent was defined as the fraction of an LD10 dose that immunosuppressed 50% of the mice when given 24 hr before mice were injected with I_b cells. The median recovery time was defined as the number of days required for 50% of the mice given an LD10 of agent to recover immunocompetence. The median lethal dose of I_b cells was defined as the dose of I_b cells that killed 50% of mice given an LD10 of agent 24 hr before I_b cells. Using these criteria it was found that the relative immunosuppressive activity of the agents in both the first- and second-set reaction was XR, CY > PRD > MTX, respectively. The effects of the immunosuppressive agents on the number and competence of immunocytes was evaluated. Immunocompetence of immune spleen cells was measured in terms of their ability to protect normal mice against an injection of 10^3 viable I_b cells. 24 hr after administration of agents (LD10) the number of spleen cells was significantly reduced. The protective capacity of individual spleen cells obtained from immunosuppressed mice also was impaired, i.e., proportionately more cells were required to achieve an equivalent protective effect (50%) compared to controls. (Diss. Abstr. Int., B)

8917 PERSISTENCE OF RADIATION-INDUCED CHROMOSOME ABERRATIONS IN MARMOSET AND MAN. Preston, R. J.; Brewen, J. G.; Gengozian, N. (Oak Ridge National Lab., TN). Radiat. Res.; 60: No. 3, 516-524(Dec 1974).

The yield of chromosome aberrations was followed for a period of 2 yr following whole-body irradiation of marmosets, and for 3 yr following an accidental whole-body exposure of a human. The yield of dicentrics plus rings decreased significantly 1 wk after irradiation of marmosets, but did not change in man until 5 wk after exposure. The yield of dicentrics and rings in the human has remained relatively constant for 3 yr, at one-half that immediately after irradiation. In the marmosets, a further decrease in yield was observed at 30 wk following 300 R and at 45 wk following 100 R, so that the yield was around 2%, compared with 40% immediately after 200 R and 15% immediately following 100 R. The yield remained at this low level through 90 wk after exposure. These differences in the persistence of aberrations in marmoset and man are considered both in terms of the different patterns of lymphocyte recovery in the two species following irradiation, and in terms of differences in lymphocyte turnover rate and life-span, once the lymphocyte count had returned to preirradiation levels. (auth)

8918 ACUTE AND CHRONIC EFFECTS OF X IRRADIATION ON BLOOD FLOW IN THE MOUSE LIMB. Horn, N. L.; Thompson, M.; Howes, A. E.; Brown, J. M.; Kallman, R. F.; Probert, J. C. (Stanford Univ. School of Medicine, CA). Radiology; 113: No. 3, 713-722(Dec 1974).

The right hind limbs of male C3H mice were treated with fractionated x irradiation to total doses of 4,000 to 7,000 rads. Estimates of mean limb blood flow were obtained from the control and irradiated limb under both resting and tourniquet-induced hyperemic conditions at intervals of up to 30 weeks postirradiation by measuring the rate of clearance of inhaled xenon-133. Under resting conditions, the irradiated limbs showed a significantly increased clearance rate. However, following temporary ischemia, a marked, progressively developing inability of the irradiated limb to undergo reactive hyperemia was found. A correlation of this change with the progressively developing late necrosis of the leg was noted. (auth)

8919 INHIBITION OF RADIATION-INDUCED LYMPHATIC LEUKEMIA IN C57BL MICE BY 19S ALPHA-2-GLOBULIN (α_2-MG) FROM HUMAN BLOOD SERUM. Berenblum, I.; Burger, M.; Knyszynski, A. (Weizmann Inst. of Science, Rehovot, Israel). Radiat. Res.; 60: No. 3, 501-505(Dec 1974).

The specific protein, 19S alpha-2 globulin (or α_2-MG), derived from human serum, which had previously been shown to antagonize some ot the acute effects of radiation damage, is now shown to be capable of also inhibiting leukemogenesis by whole-body x-irradiation. Its action, both qualitatively and quantitatively, thus seems to be identical with that of α_2-MG derived from sheep spleen, the material mainly used in the earlier studies. (auth)

8920 HYPOTHALAMIC NUCLEI OF RATS AFTER HEAD IRRADIATION AND ADRENOCORTICAL HORMONE TREATMENT. Hristic, M.; Pantic, V. (Bioloski Inst., Belgrade). Int. J. Radiat. Biol.; 26: No. 2, 147-159(Aug 1974).

The cells of the hypothalamic nuclei of intact and adrenalectomized rats, after head irradiation and adrenocortical hormone treatment, showed the following effects: the diameter of the neurosecretory cells of the nucleus supraopticus (NSO) and the quantity of neurosecretory substance were decreased 15 days after head irradiation of intact rats, but 30 days after irradiation the cells hypertrophied and signs of re-establishment of neurosecretory activity were evident. The hypertrophic cells with Gomori positive substance observed 15 and 30 days after adrenalectomy were vacuolated and the quantity of neurosecretory substance was decreased if the head was irradiated. However, neurosecretory material was maintained and signs of agglomeration were observed 30 days after treatment with deoxycorticosterone acetate plus hydrocortisone. Neurosecretory cells of the nucleus paraventricularis, which are more sensitive to irradiation than those of the NSO of both intact and adrenalectomized rats, showed less degenerative change after treatment with adrenocortical steroids. Medial and posterior hypothalamic regions were the most sensitive, and the number of ependimal cells was increased. (auth)

8921 LETHAL RESPONSE OF C57BL MICE TO 10 MeV X-RAYS AND TO ^{60}Co GAMMA-RAYS. Feola, J. M.; Song, C. W.; Khan, F. M.; Levitt, S. H. (Univ. of Minnesota, Minneapolis). Int. J. Radiat. Biol.; 26: No. 2, 161-165(Aug 1974).

The LD$_{50/30}$ of female and male C57BL mice was used as an end-point to estimate the RBE of 10 MeV x rays at a dose-rate of 35 rads/min, and the RBE of ^{60}Co gamma rays at a dose-rate of 6 rads/min, using the LD$_{50/30}$ of ^{60}Co gamma rays at a dose-rate of 35 rads/min as the baseline. The RBE of 10 MeV x rays at 35 rads/min and that of ^{60}Co gamma rays at 6 rads/min were found to be 1.00 ± 0.03 and 0.72 ± 0.04, respectively. (auth)

8922 CELLULAR IMMUNITY TO LEISHMANIA DONOVANI. I. The Effect of T Cell Depletion on Resistance to L. Donovani in Mice. Skov, C. B.; Twohy, D. W. (Michigan State Univ., East Lansing). J. Immunol.; 113: No. 6, 2004-2011(Dec 1974).

C57BL/6J mice were subjected to various combinations of immunosuppressive treatments and infected i.v. with amastigotes of Leishmania donovani. In normal mice the parasite population reached its peak about 24 days post-infection, after which parasite numbers gradually declined but they were still detectable on day 60. The course of infection was not altered in mice which had been thymectomized, lethally irradiated, and reconstituted with syngeneic marrow cells. Moderate suppression of acquired resistance resulted when thymectomized-irradiated mice were reconstituted with marrow cells which were previously treated with antibrain associated θ serum and/or when recipient mice were treated with azathioprine on the same day they were infected. Splenectomy alone or together with irradiation failed to suppress immunity, but a long-lasting high level of immunosuppression resulted when splenectomy was combined with all the above treatments. These results suggest that small numbers of thymus-dependent cells which survive irradiation and thymectomy or which may be present in the bone marrow may be sufficient to mount an immune response to L. donovani in mice, and that T cells play an important role in acquired resistance to L. donovani in mice. (auth)

8923 CELLULAR EVENTS IN TOLERANCE. III. Carrier Tolerance as a Model for T Cell Unresponsiveness. Sanfilippo, F.; Scott, D. W. (Duke Univ. Medical Center, Durham, NC). J. Immunol.; 113: No. 6, 1661-1667(Dec 1974).

Lewis rats pretreated with 10 mg of the soluble supernatant of ultracentrifuged sheep γ-globulins (ShIgSo) and challenged with trinitrophenylated (TNP)-ShIg in adjuvant initially developed significantly fewer anti-TNP plaque-forming cells than untreated controls. The effect was specific because ShIgSo tolerant rats responded normally to TNP-rabbit γ-globulin. Carrier tolerance lasted at least 6 months and could be induced with as little as 100 μg ShIgSo. Adoptive transfer experiments to irradiated recipients demonstrated that thymocytes could reverse carrier unresponsiveness. Suppressor cells were not detectable in carrier tolerant spleen populations. The diminution of responsiveness to TNP on a tolerated carrier thus provides a model for the study of T cell unresponsiveness in vivo. (auth)

8924 VARIATION IN T AND B CELL DEFICIENCY IN DIFFERENT MOUSE ALLOGENEIC RADIATION CHIMERAS. Urso, P.; Gengozian, N. (Oak Ridge Associated Univ., TN). J. Immunol.; 113: No. 6, 1770-1779(Dec 1974).

The immunologic deficiency of allogeneic radiation chimeras was examined in vitro by culturing spleen cells of the chimera with allogeneic or syngeneic (to donor-type cells of the chimera) activated thymus-derived (T) cells (ATC) or bone marrow-derived (B) cells. The plaque-forming cell (PFC) response to sheep RBC of spleen cells from 100% of the CD2F$_1$ → C3BF$_1$ chimeras was improved considerably (27-fold) with allogeneic ATC but syngeneic ATC gave only a 2-fold increase. Allogeneic B cells induced a moderate increase (4-fold) in the response of spleen cells from only 19% of the chimeras while syngeneic B cells were ineffective. With spleen cells from the reciprocal C3BF$_1$ → CD2F$_1$ chimera there was only a 7-fold increase in the response with allogeneic ATC in 38% of the chimeras and only a 2- to 3-fold increase in 18% with syngeneic ATC. In contrast, there was a 27-fold increase in PFC in about 45% of these latter chimeras with allogeneic B cells while syngeneic B cells failed to improve the response. The PFC generated in mixtures involving both types of chimera spleen cells cultured together were typed with specific isoantiserum and shown to be of CD2F$_1$ origin. These results demonstrate that deficiency in the interacting cellular components of the spleen will vary in different chimeras. Thus, CD2F$_1$ → C3BF$_1$ chimeras are primarily T cell deficient while those of the reciprocal combinations, C3BF$_1$ → CD2F$_1$, are deficient primarily in the B cell population. (auth)

8925 EFFECTS OF DOSE-RATE ON THE RADIATION RESPONSE OF RAT SKIN. Field, S. B.; Bewley, D. K. (Medical Research Council, London). Int. J. Radiat. Biol.; 26: No. 3, 259-267(Sep 1974).

Skin reactions and late deformities after irradiation of the feet of anaesthetized rats with 7 MeV electrons have been measured for dose-rates between 200 rads/min and 500 krads/min. For dose-rates up to 70 krads/min, there was no alteration in the effectiveness of the radiation, which implies that there is not a rapid form of repair of sub-lethal damage in rat skin. However, when the dose-rate was increased to 500 krads/min, there was a marked decrease in effectiveness. This observation was not made when the feet were anoxic, which implies that there is oxygen depletion at high dose-rate. For irradiation at 500 krads/min, given in aerobic conditions, the break-away point occurred at about 2000 rads, above which the response of the skin was similar to that when it was made anoxic. It was concluded from this observation that the sensitive cells were at a pO$_2$ of 5 to 10 mm Hg. (auth)

8926 ROLE OF SEROTONIN IN THE RADIORESISTANCE OF MONGOLIAN GERBILS. Jacobson, A. P. (Michigan Univ., Ann Arbor); Riley, R. C. Int. J. Radiat. Biol.; 26: No. 3, 269-276(Sep 1974).

Thirty-day survival of Mongolian gerbils was enhanced by 300 mg/kg serotonin intraperitoneally immediately before exposure to 1400 rads of ^{60}Co γ radiation. DL-parachlorophenylalanine (PCP) sensitized treated animals to 1400 rads, presumably by blocking biosynthesis of serotonin. PCP also produced a distinctly bimodal pattern of death after exposure. Reserpine at 0.6 mg/kg produced 100 per cent survival at 30 days after 1400 rads. This effect appeared to be due to the persistence of reserpine's effectiveness in releasing 5HT from various storage sites within the body. (auth)

Invertebrates

8927 (LA-5751-PR) PROBE ACTIVITIES. Annual Report, July 1, 1973–June 30, 1974. Holm, D. M.; Payne, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1974. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

Numerous small scale experiments and feasibility studies were performed for the United States Department of Agriculture. Subjects include: measurement of 7000 R dosimeters for screwworm fly dosage monitoring, tracking of screwworm flies by the use of radar and lasers, development of temperature monitoring, transmitters for ear canal and subdermal temperature monitoring, and identifying birds with fluorescent stains. (auth)

8928 (SAN-590X1) X-RAY INDUCED CHANGES IN DROSOPHILA GERM CELLS. Final Technical Report, September 1, 1964–August 31, 1971. Rinehart, R. R. (USAEC San Francisco Operations Office, Calif.). 1971. Contract AT(04-3)-590. 1p. Dep. NTIS $4.00.

Irradiated whole food and some food supplements induced mutations in Drosophila. Frequencies of x-ray induced sex-linked recessive lethal mutations in spermatozoa and oogonia indicated a dose-rate effect in oogonial but not spermatogonial cells above a dose-rate of 3000 R/hr. There was an increase in sex-linked recessive lethal frequencies among sperm aged for 3 weeks. Nitrogen oxides and amines increased histidine reversion mutation frequencies in Salmonella. (HLW)

8929 (STI/PUB-364) STERILE-INSECT TECHNIQUE AND ITS FIELD APPLICATIONS. Panel Proceedings Series. Proceedings of a Panel Held in Vienna, Austria, November 13–17, 1972. (International Atomic Energy Agency, Vienna (Austria)). May 1974. 142p. (CONF-721157-). $7.00.

Separate abstracts were prepared for 13 of the 16 papers presented in these proceedings. The other three papers discusses ecological aspects of pest control in Japan, Thailand, and Austria (ERB)

For abstracts of individual papers see: 8934–8946.

8930 X-RAY INDUCED CHANGES IN THE ACTIVITIES OF ACID AND ALKALINE PHOSPHATASE IN PERIPLANETA AMERICANA. Shivaji, S. (Delhi Univ.); Rastogi, S. C. Curr. Sci. (India); 43: No. 23, 757-758(5 Dec 1974).

The sensitivity of acid and alkaline phosphatase to x irradiation with respect to sex and tissue in which the enzyme occurs was studied in cockroaches. Both the enzymes showed a decrease in activity with increased radiation dose. Acid phosphatase, irrespective of the insect's sex was more sensitive to x rays than alkaline phosphatase. However, the sensitivity of acid phosphatase varied in the two tissues studied and also with respect to the sex of the insect. (ERB)

8931 SOME BIOLOGICAL AND ECONOMIC QUALITIES OF THE SILK MOTH (BOMBYX MORI L.) AS AFFECTED BY X-RAYS. Yankov, A.; Petkov, N.; Jolov, A. Zhivotnovud. Nauki; 10: No. 4, 135-140(1973). (In Bulgarian).

The influence of x rays on some biological and economic qualities of the silk moth when seed were irradiated during the stages D_3 and E_3 was studied in 1971–1972. The x-ray source was the TH-250 apparatus, filter 0.5 Ci, 20 MA, 200 KV, distance 40 with tube 10/15 and exposure intensity of 145.1 R/min and irradiation at rates of 500, 1000, 1500 and 2000 R. The breed 11-Ya was studied, each of the subvariants being made in 3 replications each of 200 silkworm seed. It was found that radioresistance of silkworm seed embryo on x-ray irradiation differs for stages D_3 and E_3, depending on the irradiation dose. Seed x-ray irradiation during the indicated stages at 500 to 2000 R raised silkworm vitality by 0.70 to 2.95%, inducing shortening of the larval period by 6 to 42 hrs, respectively, and boosting raw cocoon yield per g silkworm seed by 1.7 to 8.8% compared with the control. (auth)

8932 COMPARATIVE MATING ABILITY OF GAMMA STERILIZED AND NORMAL FRUIT FLIES, DACUS ZONATUS. Ashraf, M.; Qureshi, Z. A.; Arif, M. D.; Hussain, S. (Atomic Energy Agricultural Research Centre, Tandojam, Pakistan). Radiat. Res.; 60: No. 3, 541-544(Dec 1974).

Mating competitiveness of Dacus zonatus (Saunders), when irradiated as mature pupae at 9 kR or as 1-day-old adults at 12 kR and caged with normal flies, was determined under laboratory conditions. The normal males were about thrice more competitive than the males irradiated in pupal stage. The irradiation of males as 1-day-old adults showed an improvement over pupal irradiation, but still they were half as competitive as the normal males. The normal males, males irradiated as pupae and adults, transferred sperm almost equally in the spermathecae of females on first mating. (auth)

8933 X-RAY INDUCED HETEROZYGOUS VIABILITY LOADS IN DROSOPHILA MELANOGASTER. Simmons, M. J. Madison, WI; Univ. of Wisconsin (1974). 84p. University Microfilms Order No. 74-19,356.

Thesis (Ph. D.).

Two large experiments were conducted in order to evaluate the heterozygous effects on viability of x-ray induced mutations in Drosophila melanogaster. Genetic damage was accumulated on several hundred second chromosomes by delivering doses of 2,500/R over either two or four generations for total x-ray exposures of 5,000 or 10,000/R. Chromosomes treated with 5,000/R were screened for lethals after the first 2,500/R installment, and then the surviving nonlethals were each used to generate families of fully-treated chromosomes. These consisted of the descendants of a single nonlethal survivor of the first treatment; their members therefore shared the same initial x-ray damage, but differed with respect to the effects of the final exposure. The chromosomes treated with 10,000/R were not grouped into families since genetic damage was accumulated independently on each chromosome in that experiment. Heterozygous effects on viability of the irradiated chromosomes were tested in both isogenic and nonisogenic genetic backgrounds. In conjunction with these tests, homozygous viabilities were determined by the marked-inversion technique. The results indicate that irradiated chromosomes which are drastic when made homozygous have deleterious effects on heterozygous viability. These results suggest that the mutants induced by high doses of x-rays are principally drastic ones which show deleterious effects on viability in heterozygous condition. The lack of evidence for either homozygous or heterozygous effects among the nondrastic chromosomes suggests that either x-rays produce very few mildly detrimental mutants, or that though numerous, their individual effects are extremely small. (Diss. Abstr. Int., B)

8934 STATUS OF THE STERILE-INSECT RELEASE METHOD AGAINST THE CHERRY FRUIT FLY (RHAGOLETIS CERASI L.) IN NORTHWEST SWITZERLAND. Boller, E. F. (Swiss Federal Research Station for Arboriculture, Viticulture and Horticulture, Waedenswil). pp 1-3 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

After a preparatory phase of 3 years, which provided the necessary background information concerning the distribution and dispersal characteristics of the pest in a 50-ha experimental orchard, a first release program with sterile cherry fruit flies was carried out in 1972. The objective of this release of about 150,000 flies was the study of the logistics and the development of the necessary techniques of marking, handling, releasing, and monitoring the flies. The flies were irradiated in the adult stage with 10 krad, marked topically and orally (fluorescent color and rare earths) and released twice a week for 5 weeks. Extraordinary meteorological conditions and an extremely low cherry crop introduced unexpected problems but increased our experience for future operations. (auth)

8935 STATUS OF MEDITERRANEAN FRUIT FLY CONTROL BY THE STERILE-MALE TECHNIQUE ON THE ISLAND OF PROCIDA. Cirio, U.; de Murtas, I. (CNEN, Rome). pp 5-16 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

A further control experiment conducted on the Island of Procida, based principally on the application of the sterile-insect technique, clearly demonstrated that Ceratitis could be eradicated, even in its most favorable environment. Data on the control of fruit infestation, the fertility of the eggs, and the trappings, showed that the very low infestation on the island from August 1972 onwards was solely due to the immigration of already fertilized wild adult flies. (auth)

8936 REVIEW OF WORK TO COMBAT THE MEDITERRANEAN FRUIT FLY CARRIED OUT IN CENTRAL AMERICA AND PANAMA. Duron Aviles, E. (OIRSA, Tegucigalpa, Spain). pp 17-20 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

The work on medfly carried out by the Regional International Organization for Plant Protection and Animal Health (OIRSA), which includes Mexico, the countries of Central America, and Panama, is reviewed. Originally, the only OIRSA country infested by medflies was Costa Rica. In that country medflies mass-produced in San José were sterilized and released in the Puntarenas peninsula. Thereafter, large-scale releases were carried out in Nicaragua and Panama. The economics and effects of medfly control by the sterile-male technique are compared with those of other methods of control. Trials with various insecticides carried out in Nicaragua are described. (auth)

8937 PRACTICAL USE OF THE STERILITY METHOD FOR THE CONTROL OF SOFT TICKS. Galun, R.; Warburg, M.; Sternberg, S. (Israel Inst. for Biological Research, Ness-Ziona).

pp 21-25 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

Both male and female soft ticks mate several times. Males irradiated at a dose that induces 99% dominant lethals are fully competitive for 2 to 3 weeks, after which they become aspermic. Aspermia, due to inhibition of the spermatogenic cycle, occurs also when the irradiation dose is lowered to the level producing only 70% dominant lethals. Thus the irradiated ticks cease to be competitive a few weeks after treatment, even though they survive for several months. Female soft ticks cease to lay eggs after exposure to 3 to 4 kR. This dose does not reduce their mating capacity. Flooding a population with abundance of sterile females increases the mating of normal males. Argas persicus males produce more than 50 spermatophores in the presence of 10-fold females, as compared to 12 to 17 spermatophores produced by males kept at 1:1 male/female ratio. Because of the increased mating activity of the males in the presence of multiple females, the usefulness of sterile females for the control of tick populations is doubtful. (auth)

8938 GENETIC CONTROL OF RHAGOLETIS CERASI L.: PRECONDITIONS, PRESENT SITUATION, AND PROSPECTS. Haisch, A. (Bayerische Landesanstalt fuer Bodenkultur und Pflanzenbau, Munich). pp 27-35 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

At the present stage of knowledge, the technique of controlling the cherry fly genetically by releasing insects carrying dominant lethals seems to be the most promising one. Any hope of a complete eradication, however, might be unrealistic under German conditions. The objective of our research is the suppression of the pest insect to a level of population density that allows an extensive reduction of any chemical control measures for several years. The progress of the rearing experiments and the ecological studies lead to the conclusion that a final decision on the practical usefulness of the technique needs a few more years of study. The experiments in rearing and ecology are described. (auth)

8939 POSSIBILITIES OF USING GENETIC METHODS TO CONTROL THE TSETSE FLY. Itard, J. (Institut d'Elevage et de Medecine Veterinaire des pays Tropicaux, Maisons-Alfort, France). pp 37-43 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

The author reviews briefly the four main genetic methods (hybridization, chemosterilization, radiosterilization, genetic manipulation) capable of being used to control the tsetse fly. Particular emphasis is placed on the possibilities of radiosterilization, a method which has been the subject of many laboratory studies and which has begun to be used experimentally in the field. (auth)

8940 STATUS OF THE STERILE-INSECT RELEASE METHOD IN THE WORLD. Lachance, L. E. (Dept. of Agriculture, Fargo, ND). pp 55-62 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

The suppression of insect pests in the field by the sterile-insect release method (SIRM) is summarized. Some of the obstacles to the application of this method are reviewed. A number of misconceptions about the SIRM are analysed and refuted. The screwworm program in the Southwestern United States of America and Mexico is examined. (auth)

8941 CONTROL OF CERATITIS CAPITATA WIED. BY THE STERILE-MALE TECHNIQUE IN SPAIN. Mellado, L.; Arroyo, M.; Ros, P. (National Inst. of Agrarian Research (INIA), Madrid). pp 63-73 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

Since 1965 INIA has been carrying out a program for the biological control of Ceratitis capitata (Wied.) by the sterile-male technique. Preliminary experiments on the island of Tenerife and on the Spanish mainland (Province of Murcia) have shown that the method is effective when applied to small isolated areas. In 1972 a more extensive field experiment was carried out in the Province of Granada, in southern Spain. The main objective was to protect a semi-isolated area of about 100 ha (including 25 ha of regular peach orchards) exclusively by means of sterile-insect releases. The area is situated approximately 80 km from the coast at 950 m above sea level. Prior to the start of the experiment a study was made of the successive appearances of the pest from the south (on the coast), to the experimental area. Between June and October a total of 40 million pupae were irradiated in Madrid 24 to 48 hours before emergence and transported to the experimental area by train. An estimated total of 25 million adults were released. From June to September the release cages were hung outside the plantations, around the periphery. When the earlier varieties had been harvested, releases were continued both outside and inside the plantation. No chemical treatment was applied. Examination of the fruit during harvesting showed the following results: (1) in the earlier varieties not a single peach was found to be infested with C. capitata. (2) in adjacent reference areas (treated with chemicals) attacks by C. capitata on the same varieties and during the same period affected between 5 and 14%; (3) the late variety (Campiel) in the experimental area suffered infestation ranging from 0.5 to 1.6%. The results indicated that the application of the sterile-male technique was effective, and that it is possible to protect a relatively isolated area by releasing sterile insects around the periphery. (auth)

8942 POSSIBILITY OF APPLYING THE STERILE-MALE TECHNIQUE TO THE CONTROL OF TSETSE FLIES IN NIGERIA AND THE PROBLEMS TO BE FACED. Na'isa, B. K. (Federal Ministry of Agriculture and Natural Resources, Kaduna, Nigeria). pp 75-79 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

Previous methods and those still being used to control or eradicate the tsetse fly in Nigeria are briefly mentioned. The situations under which and the possible sites where the SIRM could be applied in Nigeria and the tsetse species that can be considered are also mentioned. It is concluded that the SIRM technique should continue to be investigated and tested to perfection, not only because this would silence the outcry against environmental pollution but also because it is not known when tsetse flies will develop resistance to insecticides. (auth)

8943 CODLING MOTH CONTROL BY THE STERILITY PRINCIPLE IN BRITISH COLUMBIA: ESTIMATED COST AND SOME BIOLOGICAL OBSERVATIONS RELATED TO COST. Proverbs, M. D. (Research Station, Summerland, B. C.). pp 81-88 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

The estimated annual cost of controlling the codling moth, Laspeyresia pomonella (L.), in a relatively large area (2220 hectares) by release of sterile moths is approximately $153 per hectare, which is about twice the cost of chemical control. The most expensive single item is the release of the sterile insects from helicopter. This is about 39% of the total costs. Because rearing costs are high, particular attention is given to the relationship of the prerelease infestation to the numbers of sterile insects required for control. Four years' experience in a 40 ha apple and pear orchard indicates the replacement of codling moth sprays with the sterility principle may decrease the cost of controlling other pests; probably fewer mite and aphid sprays will be needed and the status of minor pests will likely remain unchanged. Despite exceptionally promising results, British Columbia growers probably will not adopt the sterility principle of control for codling moth until costs are brought closer to those of chemical control. Costs may be appreciably reduced by releasing the sterile insects from the ground, by using less expensive ingredients in the larval diet (e.g. replacement of casein by soybean flour), and by fully mechanizing the rearing procedures. (auth)

8944 PRESENT STATUS OF THE PERUVIAN PROJECT ON MEDITERRANEAN FRUIT FLY CONTROL BY THE STERILE-MALE TECHNIQUE. Simon F., J. E. (Direccion General de Investigaciones Agropecuarias, Lima). pp 95-101 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

A brief review of the attempts for controlling or eradicating the Mediterranean fruit fly, Ceratitis capitata (Wied.), by the sterile-male technique in the isolated valleys of southern Peru from 1969 to 1972 is made. In addition, information is provided about the efforts for adequate installations, various transportation systems, and for building up a new factory for rearing medflies. (auth)

8945 FIELD EXPERIMENTS WITH THE RELEASE OF STERILIZED ONION FLIES, HYLEMYA ANTIQUA (MEIG.). Ticheler, J.; Loosjes, M.; Noordink, J. P. W.; Noorlander, J.; Theunissen, J. (Inst. for Phytopathological Research (I.P.O.), Wageningen, Netherlands). pp 103-107 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

After extensive laboratory research, radiosterilized onion flies were released in a semi-isolated wild onion fly population on a 1-ha plot during 1971 and 1972. Although all the available data have not yet been analyzed and the experiment is intended to continue for another two years, data are presented that indicate the reduction of the fertility of the wild population. Preliminary conclusions of the experiment and their implications for the future are discussed. (auth)

8946 CURRENT STATUS AND PROSPECTS OF APPLYING THE STERILE-INSECT RELEASE METHOD AGAINST DACUS OLEAE. Tzanakakis, M. E. (Univ. of Thessaloniki, Greece). pp 109-115 of Sterile-Insect Technique and its Field Applications. Vienna; International Atomic Energy Agency (1974).

From proceedings on the practical use of the sterile-male technique for insect control; Vienna, Austria (13 Nov 1972). See STI/PUB-364; CONF-721157-.

Results of research of the last three years of relevance to the sterile-insect release method against Dacus oleae (Gmelin) are briefly reviewed and their possible effect on the success of the method, when applied, is discussed. It is concluded that the outlook is still promising and that, besides the other phases of the work, small-scale releases of sterilized flies must continue to determine some problems to be faced in the field. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 8616, 8674, 8871, 8872, 8874, 8876, 8877, and 9015.

8947 (SZS-157, pp 38-41) EVALUATION OF THE RADIATION RISKS FOR ESTABLISHING RADIATION PROTECTION VALUES. Koenig, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The problem of delayed radiation effects is discussed as it applies to establishing permissible values. The incidence of leukemia and carcinomas as a result of delayed radiation effects is considered as a function of time after irradiation. The relative risk from ^{137}Cs and ^{90}Sr in fallout for causing leukemia or other malignancies is evaluated from published data. (JSR)

8948 (SZS-157, pp 50-54) EVALUATION OF RADIATION DANGERS DURING CONTAMINATION OF THE SKIN WITH PLUTONIUM AND AMERICIUM. Ershov, E. B.; Osanov, D. L.; Shamov, V. P. Mar 1974. (In Russian).

From first seminar on the radiation protection, environments, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

From experimentally obtained results on the radiation risks associated with skin contact with ^{239}Pu and ^{241}Am, previously reported in the literature, the distribution of the specific activity according to skin depth was expressed in the form of two exponents. These exponents were evaluated for hours of contact and hours after removal of the contaminating material, and the results are evaluated. The dose rate and the absorbed dose for basal skin layers were evaluated and shown graphically for a six-hour contact. The maximum permissible level for the two isotopes for skin contamination was determined. (JSR)

8949 (SZS-157, pp 100-109) INTERNAL RADIATION BURDEN FROM THE RADIONUCLIDES OF WORLD-WIDE NUCLEAR WAR FALLOUT. Moldenhawer, F. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The radiation burden to the population from nuclear weapons testing in the atmosphere is calculated for the primary fission products produced. The results are tabulated and show that ^{137}Cs and ^{14}C enter the food chain and give almost equal doses to the whole body. The ingestion of ^{90}Sr and the inhalation of ^{239}Pu affect special organs. Other radioisotopes found in the environment offer no special radiation burden except in the case of ^{131}I which can cause significant damage to children from its content in milk. (JSR)

8950 (SZS-157, pp 110-115) POPULATION DOSES CAUSED BY WORLD-WIDE FALLOUT OF ^{90}Sr FOR THE PEOPLE OF THE SOVIET UNION. Barkhudarov, R. M. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The population dose to the Russian people from ^{90}Sr released in nuclear explosions was calculated on the basis of published data on the release of the isotope in different years and on the concentration of the isotope in the human organism. (JSR)

8951 (SZS-157, pp 177-180) ESTIMATION OF ORGAN BURDENS AS A RESULT OF SIMULTANEOUS INHALATION AND SUBMERSION EXPOSURES. Stein, R.; Rossbander, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

In the case of inhalation exposure there are often several nuclides, each affecting a different critical organ. The methods used for the calculation of the radiation burden for organs in the case of the inhalation of a single radionuclide and in the case of inhalation of a mixture are briefly outlined. No results are given. (JSR)

8952 (SZS-157, pp 181-186) TRITIUM FROM NUCLEAR POWER PLANTS WITH PRESSURIZED WATER REACTORS. Krueger, F. W.; Henninger, B.; Wilhelm, H. Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The processes leading to tritium production in a pressurized water reactor are outlined. The precautions that can be taken to reduce the amount of tritium produced are given. An evaluation is made of the radiation burden resulting from tritium release to surface waters and to the atmosphere. (JSR)

8953 DETERMINATION OF THE GENETICALLY SIGNIFICANT RADIATION DOSE ATTRIBUTABLE TO THE EMPLOYMENT OF ISOTOPE DIAGNOSIS IN THE PROVINCE OF VARESE, ITALY. Mombelli, L.; Conte, L.; De Martini, M. (CURAMN, Varese, Italy). Radiol. Med.; 60: No. 8, 682-693(Aug 1974). (In Italian).

The genetically significant dose to population attributable to the diagnostic use of radioisotopes in the province of Varese (population about 700,000) during 1972 is calculated at approximately 2 mrem per person per year; 90% was derived from the use of two examinations (scintiscanning of the pancreas and functional and scintigraphic study of the thyroid). The sampling method employed is described. The results are examined in the light of possible dose reductions. (auth)

Animals

Refer also to abstracts 8977 and 8985.

8954 (LA-5810-MS) REVIEW OF THE NATURAL RESOURCES DEFENSE COUNCIL PETITION CONCERNING LIMITS FOR INSOLUBLE ALPHA EMITTERS. Healy, J. W.; Richmond, C. R.; Anderson, E. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1974. Contract W-7405-eng-36. 22p. Dep. NTIS $4.00.

The interpretations of the potential effects of insoluble alpha-emitting particles in the lung, as described in the document supporting the Natural Resources Defense Council petition of February 14, 1974, are reviewed in light of present evidence. It is concluded that the theories on which the proposal is based are not in accord with the evidence and that the theories do not correctly predict the outcome of experiments actually using such particles. (auth)

8955 (SZS-157, pp 71-74) EFFICIENCY OF SOME PROPHYLACTIC MEASURES DURING THE SIMULTANEOUS ENTRY OF ^{137}Cs AND ^{90}Sr INTO THE ORGANISM. Ramzaev, P. V.; Danetskaya, E. V.; Korzun, V. N.; Shakalova, V. V.; Ibatullin, M. S. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The prophylactic effects of the complexes Prussian blue, sodium alginate, calcium phosphate, and methionine during the daily consumption of mixtures of ^{137}Cs and ^{90}Sr in the food were studied on rats and volunteers. The Prussian blue, alginate, and calcium complexes are effective protective agents, reducing the deposition of the radioisotopes and the absorbed dose in critical organs by factors of 7 to 10. (JSR)

8956 (SZS-157, pp 79-83) IMMUNOLOGICAL REACTION UNDER THE EFFECTS OF ^{137}Cs. Nevstrueva, M. A.; Shubik, V. M.; Kolotvin, V. A.; Livshits, R. E. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The immunity indices in people with ^{137}Cs concentrations greater than 3×10^{-9} Ci/kg were determined and compared with control groups. In animal experiments on rats fed ^{137}Cs at concentrations of 10, 100, and 1000 MPC in their daily drinking water, indices of non-specific immunity were determined at the end of 1, 3, 6, 9, and 12 months. These results are tabulated and discussed. The results show that with chronic introduction of ^{137}Cs immunological changes are either absent or greatly reduced. The radiosensitivity of a wide complex of immunological reactions was determined and the tabulated results show that the radiosensitivity of different immunity indices was quite different. (JSR)

8957 (SZS-157, pp 93-97) USE OF PROTECTIVE PREPARATIONS COMBINING ISOTOPES IN THE GASTROINTESTINAL TRACT. Shamov, V. P.; Borisova, V. V. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The absorbed dose resulting from the single introduction of 1 μCi of various radioisotopes in the stomach was calculated for cases with and without the use of chemical substances inhibiting the absorption of the radioisotope. Values were reported for ^{3}H, ^{22}Na, ^{36}Cl, ^{85}Sr, ^{86}Rb, ^{137}Cs, ^{32}P, ^{45}Ca, ^{89}Sr, ^{90}Sr, ^{65}Zn, ^{75}Se, ^{87}Rb, ^{125}Te, ^{127}Te, ^{210}Po, and ^{210}Pb. The results led to the conclusion that it is advisable to use preparations combining with the radioisotopes in the intestines for the isotopes ^{3}H, ^{22}Na, ^{42}K, ^{36}Cl, and ^{86}Rb. It is necessary to use preparations for ^{85}Sr and ^{137}Cs only in those cases where the isotope is received in significant quantities. For osteotropic isotopes the use of preparations combining with the isotopes is necessary when the isotope is absorbed in significant quantities. (JSR)

8958 EFFECT OF RADIONUCLIDES ON FLOATING LARVA OF CRASSOSTREA ECHINATA. Kuwahara, R. (Tokyo Univ.). pp 18-21 of Investigation of the Effects of Low Concentrations of Radionuclides on Aquatic Life. Tokyo; Nuclear Safety Research Association (1973). (In Japanese)

The effect of ^{90}Sr on floating larva of Crossostrea echinata was examined and the result was compared with that of the experiment using fertilized eggs of Mytilus edulis which the author performed last year. Fertilized eggs of about 32 cell period were transferred to ^{90}Sr-added sea water (10^{-3} to 10^{-13} Ci/l) and after about 24 hours corrosive sublimate was added to kill the eggs, when the greater amount of the control grew to larves of trochophore. Metamorphosis rate was obtained by calculating the number of metamorphosed and non-metamorphosed individuals. As the rate of metamorphosis to larva of trochophore was extremely low in general, variations were found in the values of each experiment with various concentrations. The concentration of 10^{-3} Ci/l showed a difference in metamorphosis rate where Mytilus edulis was also affected. Crossostrea echinata was more strongly affected by radionuclides than Mytilus edulis and the former metamorphosed to larva of trochophore in lower concentration than the latter. (JA)

8959 EFFECT OF RADIONUCLIDES ON THE DEVELOPMENT AND PROLIFERATION OF MARINE PRODUCTS. Shirotani, T.; Nomakuchi, T. (Tokyo Univ.). pp 22-32 of Investigation of the Effects of Low Concentrations of Radionuclides on Aquatic Life. Tokyo; Nuclear Safety Research Association (1973). (In Japanese)

In order to examine the effect of radionuclides on the development, growth, and proliferation, an experiment using Ciona intestinalis was performed in Misaki with a good environmental condition. When Ciona intestinalis was artifically developed, it was hatched about 15 hours after fertilization, being a larva with the type of tadpole and swam. After 24 hours, it attached and metamorphosed for 3 days. The life span depended on water temperature. The number of days when half of the same fertilized eggs died was closely related with the mean water temperature. The group, in which eggs grew from autumn to next spring, survived for 6 months at 15°C of mean water temperature. However, the group, in which eggs grew in summer time, only survived for 2 months at 22°C, suggesting linear relationship between survival period and mean water temperature. Even if the experimental time and period differed, the quantity and quality of food and specific gravity of sea water were not greatly varied. (JA)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 8296, 8625, 9044, and 9053.

8960 (COO-1500-24) FATE OF INHALED RADON PROGENY. Alexander, D. R. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Aug 1974. Contract AT(11-1)-1500. 80p. Dep. NTIS $7.00.

A shadow shield whole-body counter and linear scanning techniques were used to determine the deposition and translocation of inhaled radon (^{220}Rn) progeny in volunteer human experimental subjects. The inhalation atmosphere was produced by combining nebulizer produced NaCl aerosol in a size range from 0.033 μm to 0.088 μm with ^{220}Rn progeny generated from a ^{228}Th solution. Total deposition percentages of 68% and 36% were determined for 0.033 μm and 0.073 μm aerosol respectively. An average of 54% of the deposited aerosol was found in the pulmonary region. Movement of deposited radioactivity from the respiratory tract is clearly shown to be a function of particle size. Aerosols in a size range from 0.068 μm to 0.088 μm were shown to have a biological half life of approximately 20 hours in the pulmonary region while the 0.033 μm aerosol had a biological half life of nearly 60 hours for the same region. A distinct difference in biological half life was shown between the pulmonary and tracheobronchial regions. (70 references) (auth)

8961 (PB-234695) BUREAU OF MINES, PITTSBURGH MINING AND SAFETY RESEARCH CENTER RESEARCH AND DEVELOPMENT ACTIVITIES: FISCAL YEAR 1971. (Bureau of Mines, Washington, D. C. (USA); Bureau of Mines, Pittsburgh, Pa. (USA). Pittsburgh Mining and Safety Research Center). Jul 1974. 29p. (BM-IC-8644). NTIS $3.25.

Research and technological activities pertaining to the elimination of health hazards, prevention of accidents, and promotion of survival and rescue in underground mines are reviewed. Report includes a list of publications by Pittsburgh Mining and Safety Research Center personnel. (GRA)

8962 (SZS-157, pp 55-58) REGULARITIES IN THE ACCUMULATION OF ^{90}Sr IN THE FETUS IN A PERIOD OF GLOBAL FALLOUT. Borisov, B. K. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The ^{90}Sr uptake by the human fetus was studied on the skeleton of 117 fetuses during the period from 1966 to 1967. The results showed that the skeleton of the full-term new-born infant weighs in the wet form an average of 388 ± 74 g, which is 11.4% of the body weight. 25% of the skeleton weight comes from cartilage tissue. The accumulation of ^{90}Sr in the bone tissue of fetuses has an exponential dependence on the length of pregnancy. Between the uptake of ^{90}Sr in the skeleton and the increase of the weight of the body of the developing fetus there is a linear dependence. In all periods of intrauterine development ^{90}Sr passes into the fetus in amounts 2.3 times greater than the isotope concentration in the daily food of the mother which is 1.7% of the total intake of the mother during 7 months of pregnancy. (tr-auth)

8963 (SZS-157, pp 63-67) EFFECT OF THE PHYSIOLOGICAL AND PATHOLOGICAL VARIABILITY OF THE METABOLISM OF ELEMENTS IN MAN ON THE RESULTS OF INDIRECT OR CIRCUMSTANTIAL DOSIMETRY. Ushakova, A. P.; Likhtarev, I. A.; Arkhangel'skaya, G. B.; Zvonova, I. A.; Krasnoshchekova, G. P.; Korelina, N. F. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The use of a mathematical model of the metabolism of radioisotopes, developed from the concept of standard man, is often used for individual indirect dosimetry. The limitations which must be placed on the use of this model for indirect dosimetry are considered from the viewpoint of the normal variability of the parameters of the retention function, renal and organoid clearance of the blood, and diet. In the case of pathology of the exchange systems, and particularly breakdown in the excretion of the radioisotope, indirect dosimetry must be used with many precautions. (JSR)

8964 ISOTOPE EFFECT IN METABOLISM OF RADIOACTIVE CORISOL IN MAN. Few, J. D.; Collins, K. J. (London School of Hygiene and Tropical Medicine). Nature (London); 251: No. 5473, 324(27 Sep 1974).

Studies were made of the uptake and metabolism of cortisol injected intravenously into a number of human subjects. A mixture of 1,2-^{3}H and 4-^{14}C cortisol was used. Substantial evidence of an isotope effect was obtained from blood and urine chromatographic analyses. It was found that the behavior of 4-^{14}C cortisol more closely resembles that of unlabeled cortisol than does the T-labeled form, and significant differences may occur between the metabolism of unlabeled cortisol and its 1,2-^{3}H derivative. While these findings do not necessarily invalidate the use of 1,2-^{3}H cortisol for metabolic tracer studies of steroid metabolism, there may be circumstances where knowledge of isotope effects could significantly influence the interpretation of results. (UK)

8965 METABOLISM OF RUTHENIUM IN MAN. Yamagata, N. (Inst. of Public Health, Tokyo). Kagaku No Ryoiki; 28: No. 5, 398-404(May 1974). (In Japanese).

Metabolism of ruthenium in man was examined by ingesting artificial salt-water-cultured clams treated with ^{103}Ru-nitrosyl ruthenium. Raw clams containing a certain amount of ^{103}Ru were given to healthy men. ^{103}Ru in the whole body was measured up to 58 days after the intake. The excrement was measured for 11 days after the intake. The examination revealed that approximately 95% of ^{103}Ru was excreted during three days after the ingestion. The intestinal absorption was examined by giving orally one tenth the amount of ^{103}Ru to the same subjects 12 weeks after the first experiment. The measurement of excrements on the 2nd and 3rd day led to the assumption that the intestinal absorption rate of ^{103}Ru may be 4 to 5%. In order to examine the movement of ruthenium in the body with time after the administration of ^{106}Ru, ^{106}Ru distributions from 15 minutes to 20 hours, from 20 hours to 4 days, from 7 days to 172 days were observed. Biological half-life was also examined. The accumulated amount of ^{106}Ru was about 1%, 100 days and about 0.1%, 2 years after the administration. (JA)

8966 DATA. Section IV. Other Data. Radiat. Data Rep.; 15: No. 10, 683-695(Oct 1974).

Data are presented on the ^{90}Sr level in human vertebrae during 1972. Samples were taken from 1-week-old to 90-year-old people living in either New York City or San Francisco. Data are also presented on the environmental levels of radioactivity at the Portsmouth Area Gaseous Diffusion Plant at Piketon, Ohio and the Shippingport Atomic Power Station at Shippingport, Pennsylvania during 1972. (ERB)

8967 COMPARATIVE STUDY OF THREE ^{99m}Tc-LABELED PHOSPHORUS COMPOUNDS AND ^{18}F-FLUORIDE FOR SKELETAL IMAGING. Ackerhalt, R. E.; Blau, M.; Bakshi, S.; Sondel, J. A. (Roswell Park Memorial Inst., Buffalo, NY). J. Nucl. Med.; 15: No. 12, 1153-1157(Dec 1974).

The advantages of ^{99m}Tc-labeled bone-imaging agents have stimulated a considerable amount of work toward the development of these radiopharmaceuticals. A comparison was made of the biologic properties of ^{99m}Tc-labeled Sn-polyphosphate, Sn-pyrophosphate, Sn-1-Hydroxyethane-1-diphosphonate (EHDP), and ^{18}F-fluoride. Three-hour distribution studies were done in rabbits for each radiopharmaceutical. These radiopharmaceuticals were also administered to patients, and scans were obtained between 3 and 4 hr. These scans were evaluated for background activity due to soft-tissue and blood retention. The blood clearance of ^{99m}Tc and ^{18}F was also determined in patients. On the basis of the above experiments, it was concluded that ^{99m}Tc bone-imaging radiopharmaceuticals available to date leave something to be desired in their blood and soft-tissue clearance and high kidney uptake. While the physical properties of ^{18}F are poor, the biologic properties are still superior for bone-imaging. The biologic properties of polyphosphate are significantly worse than pyrophosphate or EHDP. These latter two agents are more similar to ^{18}F in their blood clearance and soft-tissue uptake. (auth)

8968 EXPERIMENTAL SUPPRESSION OF HEPATIC UPTAKE OF ^{75}Se-SELENOMETHIONINE. Cho, K. J.; Doust, B. D. (Univ. of Michigan, Eloise). J. Nucl. Med.; 15: No. 12, 1171-1173(Dec 1974).

Preliminary infusion of unlabeled methionine into the proper hepatic artery, the distal splenic artery, or the superior mesenteric artery does not enhance the ratio of pancreatic to hepatic uptake of ^{75}Se-selenomethionine. No threshold dose rate of methionine could be found below which the liver cleared methionine entirely from the blood during one passage in dogs. Intra-arterial administration of ^{75}Se-selenomethionine into the celiac artery increases the specific activity in the pancreas but may be associated with substantial variation in activity along the length of the pancreas. (auth)

8969 NEW COMPUTATIONAL MODEL FOR DEPOSITION OF AEROSOL PARTICLES INHALED IN HUMAN RESPIRATORY SYSTEMS. Takahashi, K. (Kyoto Univ.); Ito, H. Hoken Butsuri; 9: No. 1, 3-10(Mar 1974). (In Japanese).

A computational model for deposition of particles inhaled in human respiratory systems is proposed. Weibel's model was used as a standard human lung. The calculations were performed by a method similar to Landahl's, Beeckmans' and others, with the exception of newly proposed equations for the particle deposition by impaction in the diverged parts and by tranquil diffusion in the straight parts. The calculated results were somewhat different from the ICRP's, and some examples of regional distributions of particle deposition in human lung were shown. (auth)

8970 DETERMINATION OF THE CONTAMINATION OF URINE BY MEASURING β-RADIOACTIVITY WITH A CORRECTION TO ^{40}K. Holgye, Z.; Popper, J. (Ustav Hygieny Prace v Uranovem Prumyslu, Pribram, Czech.). Chem. Listy; 68: No. 11, 1177-1184 (1974). (In Czech).

A sensitive method of determination of radioactive contamination of urine by measuring the summary β-activity of urine with a correction to ^{40}K is elaborated. The method is based on the determination of the difference between the activity of the urine dry residue and the activity corresponding to ^{40}K in a control group of unexposed persons. Using the arithmetic mean of the differences and the standard deviation the limit value was determined which is not—with high probability—exceeded by any member of the group. Exceeding this value is considered as contamination. In various control groups the dependence of the sensitivity of the method on the amount of the urine worked up was followed, as well as its dependence on the length of measurement, on the parallellity of activity determination in the same urine sample. The sensitivity increases with the amount of urine worked up, with the parallellity of the determination, and the length of measurement. As an auxiliary test for the proof of contamination Lord's test is employed for testing the correctness of the two analytical methods. (auth)

Animals

Refer also to abstracts 8668, 8811, and 9031.

8971 (CEA-CONF-2682) FIXATION OF ^{199}Tl BY THE KIDNEY MEDULLA IN MAN. Raynaud, C.; Ricard, S.; Comar, D. (CEA, 91—Orsay (France). Service Hospitalier Frederic Joliot). 1974. 18p. (In French). (CONF-740475-1). Dep. NTIS (US Sales Only) $4.00.

From 3rd international symposium on the radionuclides in nephrology; Berlin, F. R. Germany (1 Apr 1974).

The renal fixation of ^{199}Tl-HEDTA was studied in the rabbit and in miniature swine. An accumulation in the medulla was observed in both species. In man the level of renal fixation of Tl was measured 3 hr after injection and compared with the level of Hg fixation, which represents an exact renal functional index, especially of the cortex. The results for 22 patients show that the fixation of Tl is more intense than that of Hg in medullary disorders. In a case of cortical necrosis the fixation of Tl was superior to that of Hg. If these results are confirmed by a statistically significant number of cases, ^{199}Tl should be used as a medullary functional indicator at the same titer that ^{197}Hg is used as a cortical functional indicator. (HLW)

8972 (COO-1787-24) PLUTONIUM—LYMPH RELATIONSHIP. Schallberger, J. A. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Jul 1974. Contract AT(11-1)-1787. 178p. Dep. NTIS $12.00.

Uptake and transport mechanisms of soluble [$Pu(NO_3)_4$] and insoluble (polydispersed PuO_2) plutonium were studied in afferent and efferent lymph from the popliteal lymph nodes of dogs after simulated wound exposures. Normal values for constituents of canine lymph were determined. The validity of using electrophoretic techniques in studying the Pu-lymph relationship was evaluated. Lymph transport of monodispersed PuO_2 particles (0.16 μ, 0.54 μ, and 1.05 μ) was compared. The normal lymph cell count was 220 cells/mm^3 in afferent lymph and 7398 cells/mm^3 in efferent lymph. Protein concentration in afferent lymph was 13.81 ± 4.02 mg/ml, while efferent lymph contained 21.43 ± 2.80 mg/ml. Discontinuous and isoelectric focusing gel electrophoretic systems were useful in determining which proteins bind Pu, but were inaccurate in determining percentages of Pu binding to specific proteins. Plutonium nitrate concentration was higher in the acellular fraction of both afferent and efferent lymph, while a greater concentration of PuO_2 was found in the cellular fraction. Particle size was not found to be a factor in the total movement (acellular and cellular lymph fractions) of Pu in afferent and efferent lymph. Regardless of particle size, more Pu moved in the cellular fraction of both afferent and efferent lymph than in the acellular fraction. Discontinuous gel, isoelectric focusing gel, and cellulose acetate strip electrophoresis indicated that transferrin and albumin were the two principal proteins transporting Pu in the acellular fraction of both afferent and efferent lymph. Immunoelectrophoresis proved to be an inaccurate technique to study the protein-bound plutonium. Fission track analysis indicated that dissolution of Pu particles was taking place at the wound site. Plutonium oxide particles at the implant site were larger than in afferent lymph and larger in afferent lymph than efferent lymph. (auth)

8973 (COO-1787-25) STUDY OF THE TRANSLOCATION OF PLUTONIUM AND AMERICIUM FROM WOUNDS. Summary Report, April 1, 1968–June 30, 1974. Lebel, J. L. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). 2 Aug 1974. Contract AT(11-1)-1787. 267p. Dep. NTIS $16.50.

Simulated contaminated puncture wounds in beagle dogs were made by injecting plutonium of the various chemical forms handled at Rocky Flats. These included air oxidized PuO_2, $Pu(NO_3)_4$, high fired PuO_2 (850°C), and $PuCl_3$ containing ^{239}Pu, ^{240}Pu, ^{241}Am, and small amounts of contaminants. In each experiment half of the animals received intravenous injection of DTPA while the other half was untreated. Wound site excision took place only when there was evidence that the injected radionuclide was leaking from the wound site. During the time of the experiment, samples of urine, feces, and blood were collected routinely and, as the dogs were serially killed, blood and tissue samples were taken. Chemical assays for plutonium and ^{241}Am in excreta, blood, and tissues were performed for PuO_2 air oxidized, and high fired, and for plutonium nitrate. In vivo measurements were made with scintillation and solid state diode detectors, and analysis and correlation of data were carried out. Samples for histopathologic study were taken at necropsy from the tissues to be assayed. One of the dogs in the first experiment developed lymphosarcoma and, as a result of this event, ten dogs were implanted for long term observation of lymphsarcoma induction. In vivo counting of the lymph node proximal to the implants showed a rapid and relatively high deposition in the node. This prompted a study of the effect of removal of the node upon the translocation and distribution of the Pu in different chemical forms. Results obtained from the beginning of this project on April 1, 1968 until June 30, 1974 are summarized. (CH)

8974 (SZS-157, pp 59-62) DISTRIBUTION OF ALKALI AND ALKALINE EARTH ELEMENTS IN THE ORGANS AND TISSUES OF ANIMALS. Drichko, V. F.; Ponikarova, T. M.; Popov, D. K. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

Distribution of ^{22}Na, ^{86}Rb, and ^{137}Cs in organs and tissues was studied in conditions of normal and displaced exchange and that of ^{7}Be, ^{45}Ca, ^{85}Sr, ^{140}Ba, and ^{226}Ra in conditions of normal exchange. The radioisotopes were introduced in the daily food for 80 days for alkali metals and 20 days for alkaline earth metals, which is the time necessary to obtain steady distribution of the isotope between the tissues and liquids of the organism. The results obtained for muscles, liver, kidney, lungs, heart, brain, and blood were tabulated. The discrimination coefficients and selectivity of various organs were also determined. (JSR)

8975 (SZS-157, pp 84-88) METABOLISM OF RADIONUCLIDES AND ITS RELATION WITH THE BIOCHEMICAL STRUCTURAL ELEMENTS OF THE ORGANS. Zapol'skaya, N. A.; Fedorova, A. V.; Voevodina, T. M.; Borisova, V. V.; Pavlitskaya, E. D.; Nechev, Kh. K. Mar 1974. (In Russian).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

Male rats received intravenously solutions of the chloride salts of ^{90}Sr, ^{106}Ru, ^{144}Ce, and ^{239}Pu and the tissue distribution and biological half life of these radioisotopes in various tissues, organs, and albumin fractions were determined. The results obtained are tabulated. These results indicate that the exchange of radioisotopes is determined by the exchange of the albumins with which they form bonds. (JSR)

8976 (UCLA-12-966, pp 33-69) ENVIRONMENTAL BIOLOGY RESEARCH. 1974.

In annual progress report for the period ending June 30, 1974.

The division of environmental biology reports progress in the following areas of research: plant ecology; animal ecology; soil factors; and analytical techniques. (ERB)

8977 EFFECT OF RADIONUCLIDES ON THE DEVELOPMENT OF SPAWNS. Ichikawa, T.; Suyama I.; Ueno, A. (National Inst. of Radiological Sciences, Chiba, Japan). pp 1-5 of Investigation of the Effects of Low Concentrations of Radionuclides on Aquatic Life. Tokyo; Nuclear Safety Research Association (1973). (In Japanese)

Fertilized eggs of killifishes were bred in tritium solution (THO) for 6 to 7 days at 25°C after spawning to examine biological half-life of tritium incorporated into the eggs. On the 6th or 7th day, THO was changed with distilled water and ^{3}H radioactivity was measured in wet and dry eggs and in DNA extracted from eggs. The amount of tritium in wet eggs reached maximum on the 1st or 2nd day after the eggs were bathed in THO and the concentration coefficient was about 0.60. While, the radioactivity in dry eggs increased more slowly than the former, reaching maximum on the 5th or 6th day. It was about 1% of that in wet eggs. Biological half-life was within about 24 hours in wet eggs and about 1.5 to 2 days in dry eggs, but it was not exactly calculated. In DNA, the radioactivity would remain longer. Next, Fugu niphobles was employed and the egg was developed in the concentration of 10 Ci/l. The hatchability peak was observed on about 150th hours in ^{3}H-added sea water. Hatchability rate was 97% in non-added group and 88 to 89% in added group. In, addition, eye diameter measured in 20 randomly selected Fugu niphobles was 244 ± 12.9 in non-added group and 140 ± 16.7 μ in added group. (JA)

8978 TEST OF THE HYPOTHESIS THAT D_2O AFFECTS CIRCADIAN OSCILLATIONS BY DIMINISHING THE APPARENT TEMPERATURE. Caldarola, P. C.; Pittendrigh, C. S. (Stanford Univ., CA). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 11, 4386-4388(Nov 1974).

The period (τ) of a circadian pacemaker in the cockroach Leucophaea maderae is a nonmonotonic function of temperature. The slope of the curve (τ as a function of temperature) is negative at 20° and positive at 30°. When these insects are deuterated at 20° and 30° the period (τ) of the pacemaker lengthens in both cases, although there is a marked temperature dependence of D_2O action. The increase in τ is nearly three times greater at 20° than 30°. This observation is a flat contradiction of a prediction made earlier that when D_2O affects circadian pacemakers it does so by diminishing the apparent temperature of the cell. That prediction, however, involves an assumption that may well be unfounded. Unless D_2O acts nonselectively on all the components in the system regulating τ, the prediction we sought to test is unfounded; and if D_2O does not act nonselectively, the observed temperature dependence of D_2O action is understandable in terms of simulating a lower temperature for those components it does affect. (auth)

8979 DYNAMICS OF INSULIN RELEASE AND MICROTUBULAR-MICROFILAMENTOUS SYSTEM. VI. Effect of D_2O. Van Obberghen, E.; Somers, G.; Devis, G.; Ravazzola, M.; Malaisse-Lagae, F.; Orci, L.; Malaisse, W. J. (Univ. of Brussels). Endocrinology; 95: No. 6, 1518-1528(Dec 1974).

The present experiments were designed to assess the extent to which the β-cell microtubular-microfilamentous system contributes to the release of insulin evoked by glucose or sulfonylurea in the isolated perfused rat pancreas. Deuterium oxide (100%, v/v), which is thought to interfere with microtubular-microfilamentous function, was found to suppress insulin release during both the early and late phases of the secretory process. The inhibitory effect of D_2O was reversible. When the pancreases were first exposed to cytochalasin B (10 μg/ml) and, thereafter, to both cytochalasin B and D_2O, an escape phenomenon from the D_2O-induced inhibition was invariably observed in response to either glucose or sulfonylurea. This escape phenomenon supports the view that the inhibitory effect of D_2O on insulin release is mainly due to a functional sideration of the microtubular-microfilamentous system. The present data suggest, therefore, that such a system is actively involved in both phases of insulin release. (auth)

8980 INCORPORATION OF TRITIUM IN THE BODY WATER AND ORGANIC MATTER OF SELECTED MARINE INVERTEBRATES. Tucker, J. S.; Harrison, F. L. (Univ. of California, Livermore). Comp. Biochem. Physiol.; 49: No. 2A, 387-397 (1 Oct 1974).

The turnover of water and hydrogen independent of osmic forces were determined in marine invertebrates by the use of tritium as a tracer. Maximum turnover rate constants determined for body water hydrogen were 1.4 hr^{-1} (S.D. 0.060) in Mya arenaria, 1.5 hr^{-1} (S.D. 0.091) in Crassostrea gigas, and 2.1 hr^{-1} (S.D. 0.22) in Cancer productus. Turnover rates in the rapidly exchangeable compartment of the tissue-bound hydrogen of clam viscera and muscle tissue showed little difference; the maximum rate constant was 1.4 hr^{-1} (S.D. 0.15). In the viscera about 26% of the tissue-bound hydrogen was exchangeable; in the muscle about 22%. Higher average turnover rates were observed for bivalves when food organisms were present in the water. (auth)

8981 MECHANISM OF THE TUMOR AFFINITY OF ^{169}Yb, ^{67}Ga, AND ^{111}In. I. Distribution of ^{169}Yb, ^{67}Ga, and ^{111}In in the Short Term iv Injection and the Form of Chemical Bond in the Tumor Tissue. Ando, A. (Kanazawa Univ., Japan); Hiraki, T.; Sanada, S.; Hisada, K.; Ando, I. Radioisotopes (Tokyo); 23: No. 3, 161-166(Mar 1974). (In Japanese).

In order to investigate the uptake into the tumor and the form of chemical bond in the tumor tissue, the uptake of ^{169}Yb, ^{67}Ga, and ^{111}In into the tumor and the various organs was assayed at 10, 30, 60, and 120 minutes after i.v. injection, using the rats subcutaneously transplanted with Yoshida sarcoma. In these experiments, the uptake rate of ^{169}Yb in the tumor was already reached to 70% of saturated value at ten minutes post-injection, that of ^{67}Ga was reached to 50% of this value, and that of ^{111}In was already saturated at this time. From these results, it became clear that ^{169}Yb, ^{67}Ga, and ^{111}In were rapidly taken up into the tumor, and these elements taken up into the tumor were not excreted out of the tumor. And it is a well-known fact that ^{169}Yb, ^{67}Ga, and ^{111}In are not sulfur coordinator and the weak nitrogen coordinator. Considering the above-described facts theoretically, it is presumed that the chemical bond of these elements (the elements of group III in the periodic table) was not chelate ring, but ionic bond. In the organs of the animals, there are large amounts of carboxyl radical, phosphoryl radical, and sulfonic group and it might be reasonable to take them as the sites with which Yb^{3+}, Ga^{3+} and In^{3+} could be combined. (auth)

8982 DIFFERENCES IN THE DISTRIBUTION OF RADIOACTIVE BERYLLIUM CHLORIDE WITH A CARRIER AND WITHOUT A CARRIER IN THE BODY OF RATS IN THE CASE OF INTRATRACHEAL ADMINISTRATION. Kuznetsov, A. V.; Matveev, O. G.; Suntsov, G. D. Gig. Sanit.; No. 10, 113-114(Oct 1974). (In Russian).

The one-time intratracheal administration of BeCl$_2$ to rats of the maximum transferable dose (1 mg/kg) is accompanied by prolonged retention of ^{7}Be in the organism (biological half-life of about 20 days). Analogous administration of tracer amounts of ^{7}BeCl$_2$ without carrier leads to a very rapid elimination of the Be from the organism (biological half-life of one day). The intratracheal administration of BeCl$_2$ in the maximum transferable dose leads to prolonged retention of most of the isotope in the lungs and deposition in the bone tissue. (tr-auth)

8983 SKIN RESORPTION OF ^{90}Sr IN SHEEP AND LAMBS. Jordanov, I.; Gromkov, N. (Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria). Veterinaren Institut za Infektsiozni i Parazitni Bolesti). Vet. Med. Nauki (Sofia); 10: No. 3, 75-82 (1973). (In Bulgarian).

Experiments were carried out to establish the resorption, the release and the deposition of ^{90}Sr at skin treatment of sheep and lambs, with the use of exchange cells during the spring–summer season. The skin was sheared (400 sq. cm) and was treated with ^{90}Sr as a chloride without a carrier, at the rate of 1.0 to 0.5 μCi/cm^2. Results showed that the daily resorption of ^{90}Sr through the skin of sheep increases; in the last 14 days it is twice what it is in the first 6 days. With lambs the peak in the daily resorption was observed during the first days; later on the rate of resorption decreased: in the first days it was three times as much as in the sheep. On the 20th–21st day the total amount of resorbed ^{90}Sr in sheep and lambs was almost similar. In both sheep and lambs, depending on the age and the time of treatment ^{90}Sr is eliminated from 2 to 16 times less with the urine than with the feces. In adult animals' musculature the equilibrium of ^{90}Sr sets in by the 10th day, and in lambs' musculature–by the 6th day. In the bones equilibration takes place on the 20th and 10th day, respectively. The slaughter (in the region of local fallout) of adult animals should be done immediately or shortly after the nuclear explosion, and that of lambs should be done as late as possible. (auth)

8984 RADIORUTHENIUM IN MARINE ORGANISMS. II. Accumulation by Marine Organisms. Tsuruga, H. (Tokai Regional Fisheries Research Lab., Tokyo). Kagaku No Ryoiki; 28: No. 5, 410-411(May 1974). (In Japanese).

Based on various reports, ^{106}Ru concentrations in marine organisms due to water discharged from the factories for nuclear fuel disposal were examined. ^{106}Ru concentrations were examined using marine organisms collected in the water basin of Tokai Village Coast in Ibaragi Prefecture from 1969 to 1971, which were divided by kinds of food. ^{106}Ru concentration was highest in marine plants and plankton, followed by shell-fish, crustacea, and fish in this order. In general, ^{106}Ru concentration was lower in the organisms with higher nutrition level, although such a close relationship between the concentration and ashes was not observed. Shell-fish revealed high ^{106}Ru concentrations regardless of kinds of food, showing a characteristic ^{106}Ru concentration ratio of viscera to muscles from 12 to 14. The concentration coefficient was 10^3 in marine plants, 10^2 in crustacea (muscles) and 10 in fish (muscles), showing significant differences by classes. Such a large difference of ^{106}Ru concentration by nutrition level and portion of living body in marine organisms seems to be related to effects of Ru on metabolism in the living body. (JA)

8985 KINETICS OF THE SKELETAL RETENTION OF ^{239}Pu(IV). Stover, B. J.; Atherton, D. R. (Univ. of Utah, Salt Lake City). Radiat. Res.; 60: No. 3, 525-535(Dec 1974).

A kinetic analysis of the observed skeletal retention of ^{239}Pu(IV) in the beagle is presented. Since skeletal retention is directly related to bone-remodeling processes, the analysis applies only to beagles that are injected in young adulthood at dose levels <0.095 μCi ^{239}Pu (IV)/kg. At these dose levels the effect of irradiation on bone remodeling and, hence, skeletal retention, is less than the variation between animals. The kinetics are derived from these macro- and micro-observations: (1) The initial deposition and the rate of decrease in retention are both higher in bones that have a relatively greater amount of trabecular bone. One ulna, which has a relatively greater amount of cortical bone, was analyzed from each of 40 beagles at dose levels from 0.00064 to 0.095 μCi/kg and at times from 35 to 4549 days after injection. Retention of ^{239}Pu(IV) in the ulna was approximately constant over 12.5 yr, which is in contrast with the retention in the humerus and in the third lumbar vertebra. In these bones retention decreased during the first several years and then approached approximately constant values. Also, comparison of the initial concentrations shows that that of the ulna was only ≈25% that of the other two bones. (2) W. S. S. Jee has shown that ^{239}Pu(IV) deposits initially on osseous surfaces. Then through osteoblastic activity surface deposits are buried and ^{239}Pu appears diffusely in new bone. Through osteoclastic activity surface deposits are resorbed and ^{239}Pu appears in osteoclasts. Later ^{239}Pu appears in macrophages, which in the final step disappear from bone. The macro- and micro-events are consistent in time. The kinetic model that is derived could lead to the identification of a more meaningful dose rate parameter and also could provide a basis for estimating bone remodeling rates in the young adult beagle. (auth)

8986 ENZYMATIC SYNTHESIS AND USE OF ^{13}N-LABELED L-ASPARAGINE FOR MYOCARDIAL IMAGING. Gelbard, A. S.; Clarke, L. P.; Laughlin, J. S. (Sloan-Kettering Memorial Cancer Center, New York). J. Nucl. Med.; 15: No. 12, 1223-1225 (Dec 1974).

A method has been described for the enzymatic synthesis of ^{13}N-labeled L-asparagine. In vivo scanning studies have characterized the high uptake of the labeled amino acid in the myocardium and the results suggest that ^{13}N-asparagine may be a useful myocardial scanning agent. (auth)

8987 COMPARISON OF UPTAKE OF ^{67}Ga-CITRATE AND ^{57}Co-BLEOMYCIN IN TUMOR USING A SEMICONDUCTOR DETECTOR. Higashi, T.; Kanno, M.; Tomura, K. (Rikkyo Univ., Yokosuka, Japan). J. Nucl. Med.; 15: No. 12, 1167-1170(Dec 1974).

Distribution studies in Ehrlich's tumor-bearing mice were performed with ^{67}Ga-citrate and ^{57}Co-bleomycin. The tumor-to-nontumor ratios for ^{57}Co-bleomycin were always superior to those of ^{67}Ga-citrate. However, the absolute uptake in tumor of ^{67}Ga-citrate was greater than that of ^{57}Co-bleomycin. Similar results were obtained in bone, muscle, intestine, and liver. The accumulation of ^{67}Ga-citrate and ^{57}Co-bleomycin in tumor was greater than in inflammatory lesions. (auth)

8988 COMPARATIVE MYOCARDIAL UPTAKE OF INTRAVENOUSLY ADMINISTERED RADIONUCLIDES. Schelbert, H. R.; Ashburn, W. L.; Chauncey, D. M.; Halpern, S. E. (Univ. of California, San Diego, La Jolla). J. Nucl. Med.; 15: No. 12, 1092 1100(Dec 1974).

The myocardial and blood clearance rates and the myocardium-to-blood ratios for radiopharmaceuticals such as ^{43}K, ^{86}Rb, ^{129}Cs, radioiodinated oleic acid, ^{203}Pb, ^{69}Zn, and ^{99m}TcO$_4$–as a function of time were compared in rats. Attempts were made to alter these parameters by various pharmacological and dietary interventions. While ^{69}Zn, ^{203}Pb, and ^{99m}TcO$_4$–showed ratios below or only little greater than 1, ^{43}K, ^{86}Rb, and ^{129}Cs reached myocardial concentrations about 27 times higher than their corresponding blood levels. Radioiodinated oleic acid showed ratios between 1 and 6.5 depending on the specific activity. Insulin in 20% glucose was shown to cause substantial increases in the ratios for potassium, rubidium, cesium, and radioiodinated oleic acid. Digoxin and isoproterenol caused significant changes in myocardial clearance rates and therefore in the myocardial-to blood ratios. The ratios for oleic acid were decreased when the compound was injected in the fasting state. The described animal model can be helpful for determining the suitability of radionuclides for myocardial scanning and for examining the effects of pharmacologic and dietary interventions. (auth)

8989 LABELED ASIALO: HUMAN CHORIONIC GONADOTROPIN AS A LIVER-SCANNING AGENT. Birken, S.; Canfield,

R. E. (Columbia Univ., New York). J. Nucl. Med.; 15: No. 12, 1176-1178(Dec 1974).

Iodine-131-asialo–human chorionic gonadotropin was injected into rats to determine its usefulness as a liver-scanning agent. Thirty minutes after injection, 86% of the desialylated hormone is found in the liver. The specific clearance reaction of this asialo glycoprotein by hepatic parenchymal cells suggests that it can be applied as an agent for liver scanning in man. (auth)

Microorganisms

Refer also to abstracts 8653 and 8654.

8990 HEAVY WATER SLOWS THE GONYAULAX CLOCK: A TEST OF THE HYPOTHESIS THAT D_2O AFFECTS CIRCADIAN OSCILLATIONS BY DIMINISHING THE APPARENT TEMPERATURE. McDaniel, M.; Sulzman, F. M.; Hastings, J. W. (Harvard Univ., Cambridge, MA). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 11, 4389-4391(Nov 1974).

In order to test the hypothesis that deuterium oxide acts in circadian systems by simulating a lower environmental temperature, we have examined the effects of D_2O on Gonyaulax polyedra, where the period of the circadian rhythm of bioluminescent glow in constant environmental conditions is shorter at 16° than at 22°, and the phase of the glow peak relative to a light-dark cycle is advanced at 16° relative to 22°. Addition of low concentrations of D_2O to Gonyaulax does not produce the same effects on period and phase as lowering the temperature; the free running period is lengthened and the phase is delayed. These results show that in the Gonyaulax rhythm, the effect of added D_2O is not equivalent to lowering the temperature. (auth)

New Tracer Techniques

Refer also to abstracts 8307, 8332, 8811, 8967, 8968, 8986, and 8989.

8991 (AD-782675) TECHNETIUM-99m PYROPHOSPHATE FOR BONE IMAGING. Eckelman, W. C.; Reba, R. C.; Kubota, H.; Stevenson, J. S. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Apr 1974. 19p. (AFRRI-TN-74-3). NTIS $3.00.

Of the various ^{99m}Tc phosphates suggested for bone imaging, ^{99m}Tc pyrophosphate appears to have the desirable characteristics of commercial availability of sodium pyrophosphate and availability of analytical controls to assure the quality of the final product. Systematic variations of the parameters of the ^{99m}Tc tin pyrophosphate preparation were evaluated by gamma camera images in swine. These studies indicate that the best tissue distribution is obtained by adding 1.75 ml of 0.1m sodium pyrophosphate at ph 10 to 0.25 ml of 1 mg/ml tin chloride followed by 1.50 ml ^{99m}TcO$_4$(-). In vivo organ distribution indicates the importance of normalizing doses on a per weight basis for comparative animal studies. If the proper dose of phosphate is used, ^{99m}Tc pyrophosphate results in high quality bone images in animals and humans and can be easily prepared and assayed. (auth)

8992 (UCLA–12-966, pp 71-111) CLINICAL AND BASIC NUCLEAR MEDICINE. 1974.

In annual progress report for the period ending June 30, 1974.

The division of nuclear medicine reports progress in the following areas of research: clinical nuclear medicine; basic nuclear medicine; radiopharmaceutical development; cardiology; neurology; Bleomycin; femoral head studies; thumbophlebitis studies; ultrasound; biomedical cyclotron facility; nuclide metabolism section; and leukemia biology. (ERB)

8993 PREPARATION OF 17β-OESTRADIOL-6-(O-CARBOZYMETHYL)OXIME [^{125}I]-TYRAMINE FOR OESTRADIOL RADIOIMMUNOASSAY. Comoglio, S.; Saracco, B.; Rosa, U. (Univ., Pisa, Italy). J. Nucl. Biol. Med.; 18: No. 3, 98-103 (1974).

A technique of preparation of [^{125}I]-labelled oestradiol for use in radioimmunoassay has been developed. The preparation is carried out through the following steps: iodination of tyramine; conjugation with the N-succinimidyl ester of 17β-oestradiol-6-(O-carboxymethyl)oxime; and extraction with solvent. The overall yield is of 20 to 30% and the specific activity 300 μCi/μg. Comparative studies with [^{3}H]-labelled oestradiol have shown that the [^{125}I]-labelled tracer is perfectly adequate for radioimmunoassay. (auth)

8994 METABOLISM OF THE TWO ALBUMIN COMPONENTS IN HUMAN SLOW BISALBUMINEMIA. Bianchi, R. (Univ., Pisa, Italy); Mariani, G.; Pilo, A.; Toni, M. G.; Micheli, G. J. Nucl. Biol. Med.; 18: No. 3, 91-97(1974).

The two albumin peaks of a slow migrating human bisalbuminemia were separated by an original device for small scale preparative gel electrophoresis on agarose. Labelling of the two fractions was performed by the electrolytic technique with ^{131}I and ^{125}I, respectively for normal albumin and for the slow migrating one. Biological behavior of the two components was studied by measuring their catabolism and distribution (by the U/P ratio and equilibrium time methods respectively) in two normal subjects in whom the two tracers were simultaneously injected. Protein turnover was also evaluated in the bisalbuminemic subject by commercial batch human serum albumin labeled with ^{131}I. The values of plasma disappearance curves of the two albumins were practically undistinguishable in both cases, which gave identical values for catabolism. Distribution studies also showed that para-albumin behaves exactly like the normal one in respect of the ratio between the extravascular and the intravascular albumin pools and of fractional transfer rate from plasma to the extravascular space. (auth)

8995 RADIOIMMUNOASSAY OF PLASMA ALDOSTERONE. Giannotti, P.; Mannelli, M.; Fiorelli, G.; Serio, M. (Univ., Florence). J. Nucl. Biol. Med.; 18: No. 3, 104-111(1974).

A radioimmunoassay method for the determination of aldosterone in human plasma is described. After extraction with diethyl ether, aldosterone is purified by paper chromatography. The radioimmunoassay is performed using an antiserum to aldosterone-3-oxime-BSA and dextran coated charcoal. Precision, accuracy, sensitivity, and specificity have been evaluated. Comparative studies showed the possibility of large errors when the chromatographic step was omitted. The mean levels of aldosterone found in normal subjects on normosodic diet in recumbent and upright position are reported. (auth)

8996 RADIOIMMUNOASSAY OF HUMAN SERUM ALBUMIN IN PERITONEAL DIALYSATE. Bianchi, R. (Univ., Pisa, Italy); Mariani, G.; Masini, S.; Matera, F.; Zucchelli, G. C. J. Nucl. Biol. Med.; 18: No. 3, 112-118(1974).

A radioimmunoassay procedure for the determination of albumin in peritoneal dialysate has been developed, which presents some modifications in respect to a method previously introduced for the measurement of urinary albumin in normal subjects. Experimental validation performed by the usual procedures gave large evidence of the precision, accuracy, specificity, and sensitivity of the measures obtained by the proposed method. The main peculiarities of the procedure are the use of a single antibody, the separation of free from bound antigen by filtration through 0.45 μm filters, and the electrolytical labelling of the antigen at a relatively low specific activity (20 to 35 μCi/mg). The radioimmunoassay technique has been applied to each dialysate sample collected during a total of 5 peritoneal dialyses carried out on 3 uremic patients undergoing maintenance peritoneal dialysis. Peculiar behavior of the albumin loss during peritoneal dialysis has been pointed out, the highest protein loss occurring by the inter-dialysis fluid left in the abdomen. (auth)

8997 THEORETICAL BASES FOR THE CALCULATION OF THE REGIONAL VENTILATION/PERFUSION RATIO (V/Q) OF THE LUNG IN THE NEWBORN. Ronchetti, R. (Univ., Parma, Italy); Benci, S.; Federict, E.; Manfredi, M.; Ciofetta, L.; Gentili, G. J. Nucl. Biol. Med.; 18: No. 3, 123-135(1974).

A compartmental study of the lung of the newborn was undertaken in order to evaluate the possibility of a correct determination of the regional $\dot{V}/\dot{Q}$ ratio by means of ^{133}Xe. The results showed that significant errors are possible in the newborn if Ball's method, routinely employed in adults, is used. A method based on the analysis of the time dependence of wash-in curves obtained with continuous infusion or inhalation of ^{133}Xe at constant concentrations is described. By means of this method correct comparison of $\dot{V}/\dot{Q}$, $\dot{V}$, and $\dot{Q}$ of the different lung zones is possible. (auth)

8998 METABOLISM OF GLYCINE AND THYMINE LABELLED WITH ^{14}C AND ^{3}H IN NORMAL AND LEUKEMIC LEUCOCYTES. Notario, A.; Ricetti, M.; Trpin, L.; Pallavicini, E. B. (Univ., Pavia, Italy). J. Nucl. Biol. Med.; 18: No. 3, 136-153 (1974).

Studies have been performed with the aim of controlling the metabolism of glycine and thymine double labelled (with ^{14}C and ^{3}H) in the normal and leukemic leucocytes, with the purpose of better establishing the effective differences in protein and nucleoprotein metabolism of the two substances. The results obtained have shown a clear difference between the normal and the pathological cells of the peripheral blood. Furthermore, it was possible to establish both for the glycine and for the thymine that part of the substances are utilized, both in normal and in leukemic leucocytes, for metabolic pathways different from the protein and nucleoprotein synthesis. In particular, part of the labelled substrates are also found in the lipidic fraction, in cold acid soluble fraction, and the ^{14}C was partly required in CO_2. A decrease of global utilization of the two substances was also observed in the leukemic cells with a dissociation among CO_2 production, proteins synthesis, and utilization of the substrates for DNA and RNA metabolism. (auth)

8999 RADIOIMMUNOASSAY OF ARGININE VASOTOCIN. Rosenbloom, A. A.; Fisher, D. A. (Harbor General Hospital, Torrance, CA). Endocrinology; 95: No. 6, 1726-1732(Dec 1974).

A method for the radioimmunoassay of arginine vasotocin has been developed using methods and antisera previously utilized in the measurement of serum arginine vasopressin. For assay of biological samples containing both vasotocin and vasopressin, simultaneous measurement of duplicate samples is conducted with two antisera. Samples known to contain only vasotocin require the use of only one antiserum. In mammalian samples ^{125}I-vasopressin is used as labeled antigen, but in vasopressin-free samples (nonmammalian vertebrate samples) ^{125}I-vasotocin serves as labeled antigen and provides greater sensitivity and specificity. Measurements of pituitary content of vasotocin in chickens and vasopressin in rats provided results consistent with previously reported data. Application to bullfrogs revealed increasing levels of serum immunoreactive vasotocin with increasing dehydration. (auth)

9000 DEVELOPMENT OF A RADIOIMMUNOASSAY FOR BLASTOKININ. Mayol, R. F.; Longenecker, D. E. (Mead Johnson Research Center, Evansville, IN). Endocrinology; 95: No. 6, 1534-1542(Dec 1974).

A radioimmunoassay has been developed for the qualitative measurement of blastokinin in flushings or extracts of rabbit uteri. The RIA utilizes guinea pig anti-blastokinin serum and is capable of detecting blastokinin in the range of 0.3 to 2.0 ng of the protein. It was found that the amount of blastokinin present in uterine flushings from pregnant rabbits increased substantially on Day 3 to 20,000 ng/ml. The level increased further to 200,000 ng/ml on Day 4 and to a maximal level of 370,000 ng/ml on Day 6, which is a 2000-fold increase over the levels found on Day 0. The amount of blastokinin declined thereafter to about 5 to 10,000 ng/ml on Days 10 and 12. (auth)

9001 APPLICATION OF SUBTRACTION SCANNING TO THE DIAGNOSIS OF LUNG CANCER USING ^{197}HgCl$_2$ AND ^{131}I-RISA. Fujii, T.; Tozuka, T.; Kusama, S.; Kanai, H.; Takizawa, M. (Shinshu Univ., Nagano, Japan). Radioisotopes (Tokyo); 23: No. 3, 167-172(Mar 1974). (In Japanese).

Dual-radioisotope techniques (subtraction techniques) were applied to lung cancer as tumor scanning, using ^{197}HgCl$_2$ and ^{131}I-RISA and some basic experiments were performed. Ability to detect the lesion was increased and clinically, good results were obtained. The advantage and disadvantage of this method were discussed. (auth)

9002 DETERMINATION OF MINERAL DENSITY AND STRUCTURAL INHOMOGENEITY OF TRABECULAR BONE IN VITRO BY X-RAY FLUORESCENCE LINE SCANNING. Patomaki, L.; Olkkonen, H. (Kuopio Univ., Finland). Int. J. Appl. Radiat. Isotop.; 25: No. 9, 401-406(Sep 1974).

An isotope excited x-ray fluorescence method was utilized in determination of the mineral density of cancellous bone in vitro. The bone samples from the anterior iliac crest were irradiated by a 20 mCi ^{55}Fe annular source. The photoelectric absorption of exciting radiation yielded Ca x-rays, which were measured by a Si(Li) detector and a multichannel analyzer. A linear correlation ($r = 0.90$) was found between the bone mineral density and the mean Ca x-ray count rate. This correlation equation was employed for the system calibration. A new kind of line scanning procedure was developed for the measurement of the structural inhomogeneity of trabecular bone. The method involved the calculation of the coefficient of variation (CV) from 10 measurements along a line at 1-mm intervals. For the heterogeneous material, CV varied between 1 and 12%. For the normal and osteoporotic bone samples, CV varied between 2 and 8%, and 9 and 14%, respectively. The mineral density of osteoporotic bones was clearly lowered and also showed a decrease with increasing age. (auth)

9003 QUANTITATIVE METHOD FOR MEASURING RADIOACTIVITY IN TISSUES SECTIONED FOR WHOLE-BODY AUTORADIOGRAPHY. Cross, S. A. M.; Groves, A. D.; Hesselbo, T. (Smith Kline and French Labs. Ltd., Welwyn Garden City, Eng.). Int. J. Appl. Radiat. Isotop.; 25: No. 9, 381-386(Sep 1974).

Radioactivity in tissues sectioned for whole-body autoradiography can be rapidly measured by matching the density of a tissue autoradiograph to a calibrated scale incorporated on the same x-ray film. The accuracy is increased by using a small aperture densitometer. (auth)

9004 DIFFERENTIAL DIAGNOSIS OF THE RENAL SCINTIGRAM. Suzaki, K. (National Hospital of Sapporo); Sakurai, T.; Moriya, H.; Hareyama, M.; Tsutsuji, Y. Radioisotopes (Tokyo); 23: No. 3, 179-185(Mar 1974). (In Japanese).

Diagnostic approach was done in 92 cases with renal scintiscanning with ^{197}Hg-chlormerodrin. Especially, differential diagnosis in space occupying lesions such as renal tumor, renal cyst, renal tuberculosis, and metastatic retroperitoneal tumor was clinically analyzed. These diseases might have no characteristic pattern on the scintigrams, but some characteristic pictures were obtained in many cases. In addition, the scintigrams of other renal diseases were mentioned. Diagnostic significance was observed in not only space occupying lesion, but also malformation, renal insufficiency, and vascular diseases. As ^{197}Hg has low energy, it was safe in exposure dose, and there was no side effect. Scintigram is superior for resolution, and is applicable for side diagnostic method. However, over-estimation on diagnosis using this method should not be made. (auth)

9005 SERIAL CHANGES IN LIVER SCINTIGRAM OF INFANTS WITH ^{131}I-BSP. I. Congenital Atresia of the Bile Ducts. Nagase, K.; Maruo, K. (Juntendo Univ., Tokyo). Radioisotopes (Tokyo); 23: No. 2, 106-112(Feb 1974). (In Japanese).

A scintigraphy and a linear scan in 23 patients with congenital atresia of the bile ducts using ^{131}I-BSP, and compared to discriminate from those in infantile hepatitis. The liver scintigrams and the linear scans were taken immediately, 3 hours, and 24 hours after the intravenous injection of ^{131}I-BSP. In congenital atresia of the bile ducts, the scintigram revealed no picture of ^{131}I-BSP excreted in the intestinal tract even after 24 hours, but many pictures excreted in the kidney in general. In linear scanning study, the scanning curves were similar in every test time, there being many backgrounds. In infantile hepatitis, on the other hand, the scintigram showed the increasing excretion in the intestinal tract with time and the reducing background. Also in the linear scan, the curves showing the excretion in the intestinal tract were obtained. (auth)

9006 RADIOIMMUNOASSAY OF HUMAN TSH AND ITS CLINICAL APPLICATION. Enomoto, K.; Inoue, K.; Enomoto, H.; Nukui, T.; Kuroda, M. (Toho Univ., Tokyo). Radioisotopes (Tokyo); 23: No. 2, 101-105(Feb 1974). (In Japanese).

We have tested the TSH radioimmunoassay kit (Daiichi Radioisotope Labs., Ltd.) for its basic and clinical determinations. The results of serum TSH in various clinical states and TRH tests were also reported. The sensitivity, reproducibility and recovery of the assay were satisfactory. In normal subjects, serum TSH showed 5.6 μU/ml in average, hyperthyroid subjects showed low, and primary hypothyroid subjects showed high levels. With TRH tests, hyperthyroidism showed low or no response, whereas primary hypothyroidism showed exaggerated and delayed response. In secondary hypothyroidism, increase or no increase of serum TSH were observed. In observed values, there was a good correlation with the values obtained by the use of NIH kits. (auth)

9007 DETERMINATION OF TRIIODOTHYRONINE IN HUMAN SERA USING RADIOIMMUNOESSAY KIT. Hara, M.; Sato, K.; Kayamori, R. (Niigata Univ., Japan). Radioisotopes (Tokyo); 23: No. 2, 97-100(Feb 1974). (In Japanese).

Triiodothyronine (T-3) concentration in sera from normal subjects and patients with various thyroid disorders was determined using radioimmunoassay kits. Value of normal subjects showed 135.8 ± 24.9 ng/dl and there was no difference between male and female subjects. T-3 concentration in sera of hyperthyroid patients was 549.6 ± 203.9 ng/dl and that in hypothyroid was 20 ng/dl. T-3 concentration in sera of patients who had received ^{131}I therapy or antithyroid drugs administration for thyrotoxicosis showed normal value. Sera from hypothyroid patients who were under treatment with thyroid hormone and maintained normal metabolic rate also showed normal T-3 level. Result of T-3 concentration determination, T-3 test and T-4 test showed correlation of some degree. (auth)

9008 HYPOTONIC EXCHANGE LOADING OF HUMAN ERYTHROCYTES WITH ^{59}Fe-LABELED RABBIT HEMOGLOBIN. Whitaker, T. R.; Sartiano, G. P.; Hamelly, L. J. Jr.; Scott, W. L.; Glew, R. H. (Univ. of Pittsburgh). J. Lab. Clin. Med.; 84: No. 6, 879-888(Dec 1974).

The process of hypotonic exchange loading of human erythrocytes with ^{59}Fe-labeled rabbit hemoglobin is described. Exchange occurs when 200 to 500 Å apertures are transiently produced in the red cell membrane during hemolysis in hypotonic media. On restoration of isotonic conditions, the apertures close, and the cells return to their normal size and shape. Cells exchanged with rabbit hemoglobin behave as osmometers. An exchange in excess of 50% of the hemoglobin remaining in the cells, calculated on the basis of the incorporated radioactivity, is in agreement with the amount of each hemoglobin determined by electrophoresis of the lysate of exchanged cells. Failure of pronase digestion to liberate incorporated ^{59}Fe-labeled hemoglobin from exchanged cells eliminates the possibility that the exchange phenomenon is an artifact of surface adsorption. (auth)

9009 RADIOIMMUNOLOGIC ASSAY FOR ANTITHYROGLOBULIN ANTIBODIES. Peake, R. L.; Willis, D. B.; Asimakis, G. K. Jr.; Deiss, W. P. Jr. (Univ. of Texas, Galveston). J. Lab. Clin. Med.; 84: No. 6, 907-919(Dec 1974).

A double-antibody radioimmunologic assay for antithyroglobulin antibodies (RATA) in serum is described. The assay employs human thyroglobulin labeled in vitro. The reaction product of antithyroglobulin antibodies and labeled human thyroglobulin is measured after precipitation with rabbit antihuman gammaglobulin serum. This test has a high degree of positivity in autoimmune thyroid disorders. In chronic lymphocytic thyroiditis, 100% of sera from patients with surgically proved disease were positive and 83.8% of those in whom this disease was clinically suspected were positive. In Graves' disease, 87.5% of untreated patients' sera and 57.7% of treated patients' sera were positive. In primary hypothyroidism, 94.4% of patients' sera were positive. The sera from many patients with autoimmune thyroid disorders which were negative or had low titers to the commonly used tanned red cell agglutination test (TRCA) were positive with the RATA test. Four % of sera from normal control subjects, 15% of sera from patients with other autoimmune disorders, and 8% of sera from patients with thyroid disorders not considered to be of an autoimmune etiology were positive to the RATA. The RATA is simple and quantitative with sensitivity and specificity equal to or exceeding present tests for circulating antithyroglobulin antibodies. (auth)

9010 QUANTITATION OF CYTOTOXIC ANTITUMOR ANTIBODY IN VITRO: A MICROASSAY WITH ^{125}I-IODODEOXYURIDINE AS A TUMOR CELL LABEL. Fritze, D. (Veterans Administration Hospital, Sepulveda, CA); Kern, D. H.; Pilch, Y. H. J. Nat. Cancer Inst.; 53: No. 5, 1403-1407(Nov 1974).

A micromethod is described for the quantitation of cytotoxic antitumor antibodies in which tumor cells are prelabeled with ^{125}I-iododeoxyuridine. The assay requires a total reaction time of 2 hours. Tumor-specific cytotoxic activity of 50 to 80% could be detected at high serum dilutions with syngeneic antisera absorbed with syngeneic spleen cells and could be correlated with cell loss observed visually. (auth)

9011 INCREASE AND IMPROVEMENT OF ANIMAL PRODUCTIONS BY MEANS OF NUCLEAR TECHNIQUES. de la Sierra Serrano, D. Energ. Nucl. (Madrid); 18: No. 89, 167-178(1974). (In Spanish).

The progress made as a result of the use of nuclear techniques in animal production can be classified into the principal groups of activities. First of these is the advances in animal feed obtained by the use of radioactive and stable isotopes. The nuclear techniques applicable to reproduction, hygiene, and health of the animal are then described. Experiences in Spain and other countries on the preservation of food with radiations are briefly summarized. (tr-auth)

9012 RATE OF INCORPORATION OF ^{14}C-LYSINE IN CYTOPLASMIC AND NUCLEAR PROTEINS IN THE LIVER OF HEALTHY CHICKENS AFFECTED WITH ERYTHROBLASTOSIS. Trifonov, S.; Aleksandrov, I. (Bylgarska Akademiya na Naukite, Sofia. Inst. po Obshta i Sravnitelna Patologiya). Izv. Inst. Srav. Patol. Shivotn., Bulg. Akad. Nauk.; 14: 149-157(1972). (In Bulgarian).

Studies were carried out to determine in vitro the rate of incorporation of C-lysine in the proteins of homogenate, cytoplasm, arginine rich histones (AR), lysine-rich (LR) histones and HCl insoluble nuclear proteins in the liver of healthy chickens and chickens affected with erythroblastosis. In chickens affected with erythroblastosis the values of SA (specific activity) of homogenate, cytoplasm and HCl insoluble nuclear proteins ranged within narrow limits. The arginine-rich and lysine-rich histone fractions manifested significantly higher SA. The values of SA of cytoplasm, homogenate and HCl insoluble nuclear proteins in chickens with erythroblastosis were by 3.7–4.3 times higher than the SA of the corresponding fractions in the healthy chickens. The SA of all fractions studied in incubation (Hanks solution) for 60 min both in the healthy and in the affected chickens was lower than their SA in incubation for 180 min. The rate of incorporation of amino acid in the first 60 minutes of incubation was higher than that after 60th min. The rate of incorporation in the diseased birds was higher than that in the healthy ones. Highest rate of incorporation manifested the lysine-rich histone fractions in chickens affected with erythroblastosis. (auth)

9013 THE EXPERIENCE IN RADIOISOTOPE APPLICATION IN PHYSIOLOGICAL AND BIOCHEMICAL INVESTIGATIONS CONDUCTED AT THE L'VOVSKIJ ZOOVETERINARNYJ INST. Berkovich, E. M. pp 197-204 of Isotope and Nuclear Radiation Application in Agriculture. Section 3. Isotope and Radiation Application in Husbandry and Veterinary Science. Moscow; Atomizdat (1971). (In Russian).

From all-union scientific-technical conference "20 years of production and isotope and nuclear radiation application in national economy of the USSR;" Minsk, USSR (7 Oct 1968). 14 refs.

Work carried out at the L'vov Zooveterinarian Institute on the use of radioisotopes in physiological and biochemical studies is reported. Radioactive isotopes were used in the study of the following processes: milk production, its regulation by the nervous system and humoral factors, penetrability of iron lactates, absorption processes in the digestive track, inclusion of different amino acids in the albumin of chicken eggs, and phosphorylation processes. (tr-auth)

9014 ^{99m}Tc-POLYPHOSPHATE IN DIAGNOSING MENINGIOMAS OF THE SPHENOID WING. McQuade, S.; Higgins, H. P. (St. Michael's Hospital, Toronto). J. Nucl. Med.; 15: No. 12, 1205-1206(Dec 1974).

A sphenoid-wing meningioma undetected by ^{99m}Tc-pertechnetate brain scan but easily detected by ^{99m}Tc-polyphosphate bone scan is presented. The use of this radiopharmaceutical in diagnosing this type of meningioma is discussed. (auth)

9015 COMPARISON OF BONE SCANNING AND RADIOGRAPHY FOR DETECTING BONY METASTASES OF PROSTATE CANCER. Irikura, H.; Chiba, K.; Matsui, K.; Yamada, H.; Ohishi, Y. (Tokyo Metropolitan Geriatric Medical Center). Kaku Igaku; 11: No. 2, 97-109(Apr 1974). (In Japanese).

Bony metastasis of 17 cases (66 to 88 years old, mean age of 73) with prostate cancer, being proved histologically, was studied by both bone scanning and radiography. The bone scanning was performed 3 hours after injection of 10 mCi of ^{99m}Tc labeled pyrophosphate using minified whole body scanner and life size rectilinear scanner in the interesting regions. Cases examined were classified into five groups according to the spread of metastases; stage I to IV. Thirteen (76%) out of 17 cases indicated abnormal findings by both bone scanning and radiography. However, nine (64%) out of 14 cases with bone metastases were observed in scan. This agrees with the results from the comparison of staging by scanning and by radiography. One case with normal bone scan showed abnormal radiographic silhouette in the 3rd lumbar vertebra, which is thought benign osteosclerosis after 7 months of follow-up. These results indicate that bone scanning is superior for the detection of metastases to x-ray study. This suggests bone scan is suitable for early detection; screening of bone metastases of prostate cancer resulted in no abnormal finding with x-ray study. Six (67%) among 9 cases grouped into stage III or IV by bone scanning showed a highly significant increase of both serum alkaline and acid phosphatases. In seven cases with widely spread metastases, neither kidney nor urinary bladder was visualized with ^{99m}Tc pyrophosphate; the scan indicates that metastatic bone lesions are widely spread out. (JA)

9016 EVALUATION OF LUTEAL FUNCTION THROUGH SERIAL DETERMINATION OF PLASMA PROGESTERONE. Ito, K. (Nagoya Univ., Japan). Nippon Sanka Fujinka Gakkai Zasshi; 26: No. 1, 15-23(Jan 1974). (In Japanese).

In order to know the luteal function, competitive protein binding assay, by which plasma progesterone was continuously determined with the advantages such as comparatively simple, rapid measurement and high sensitivity was used and the results were obtained as follows. In four cases with normal menstrual cycles, blood progesterone was gradually increased at the time of ovulation. It approached the peak after 5 to 8 days of ovulation, and then, it was gradually decreased. The variation of the secretion value was studied until the 15th week of pregnancy in 55 specimens including 3 cases who were continuously measured and 35 cases who were occasionally measured. The value before 10 weeks of pregnancy was almost the same as the maximum one at the luteal phase, and it was increased after about 12 weeks. The state of progesterone secretion in the artificial ovulatory cycle caused by hCG administration was observed. In addition, when 3000 units of hCG was administered for 3 to 5 days at the luteal phase, the luteal phase was prolonged by the increase of progesterone. The luteal phase was shortened by the decrease of progesterone due to 19-norethisterone administration in 3 cases. Tritium was used as the labeling radioisotope for measurement. (JA)

9017 RENAL SCINTIGRAPHY WITH ^{197}Hg-CHLORMERODRIN. Watanabe, K.; Kamoi, I.; Kawahira, K.; Morita, K. (Kyushu Univ., Fukuoka). Radioisotopes (Tokyo); 23: No. 3, 173-178(Mar 1974). (In Japanese).

Renal scintigraphy by ^{197}Hg-chlormerodrin was fundamentally and clinically studied. The effect of low energy of ^{197}Hg x-rays on scintigraphy was studied with phantom experiment, as compared with ^{203}Hg. There was almost no difference up to 5 cm of absorption layer between them. Slight effect of scattering was observed in 10 cm of absorption layer. The degree of decrease of counting rate due to absorption did not almost change up to 5 cm. In 10 cm, the counting rate of ^{197}Hg decreased to 30 ± 5%, as compared with 55 ± 5% of ^{203}Hg. Renal scintigraphy with ^{197}Hg-chlormerodrin was clinically done in 21 cases. The scan picture obtained with ^{197}Hg-chlormerodrin was almost similar to that with ^{203}Hg-chlormerodrin. It was emphasized that this radiopharmaceutical should be widely used to decrease exposure dose to the kidney. (auth)

9018 RETICULOENDOTHELIAL SCANS IN DISORDERS INVOLVING THE BONE MARROW. Schreiner, D. P. (Univ. of Pittsburgh). J. Nucl. Med.; 15: No. 12, 1158-1162(Dec 1974).

Reticuloendothelial (RE) scans using ^{99m}Tc-sulfur colloid were performed on 58 patients with diseases affecting the bone marrow. All leukemic patients had decreased marrow activity and variable degrees of hepatosplenomegaly. The pattern of RE marrow activity in patients with lymphomas was variable but focal defects on marrow scan were usually associated with histologic evidence of lymphoma in the marrow. Decreased RE marrow activity occurred in multiple myeloma and two patients had focal defects on scan when skeletal x-rays were normal. Hemolytic or hemorrhagic anemias were associated with increased RE marrow activity but scans in aplastic anemia were normal. Myelophthisic anemia and myelofibrosis were associated with decreased central marrow activity and peripheral expansion of the marrow space. Fifty percent of patients with terminal renal disease had decreased RE marrow activity. Certain patterns of RE activity and distribution have been established for some disorders but these patterns may not always reflect the distribution or activity of hemopoietic tissue. (auth)

9019 RADIONUCLIDE CEREBRAL ANGIOGRAPHY IN DIAGNOSIS AND EVALUATION OF CAROTID-CAVERNOUS FISTULA. Matin, P.; Goodwin, D. A.; Nayyar, S. N. (Veterans Administration Hospital, Palo Alto, CA). J. Nucl. Med.; 15: No. 12, 1105-1109(Dec 1974).

The use of radionuclides and the γ camera for the visualization of cerebral blood flow is useful in the diagnosis and followup of patients with carotid–cavernous fistula. The procedure involves an intravenous injection of a small bolus of ^{99m}Tc-pertechnetate followed by rapid-sequence images of the flow of the label through the cerebral vessels. This technique is simple, safe and may be repeated at frequent intervals. (auth)

9020 UNUSUAL ARTIFACT IN LATERAL LIVER SCANS. McCauley, D.; Baunstein, P. (New York Univ., NY). J. Nucl. Med.; 15: No. 12, 1201-1202(Dec 1974).

Focal defects in the upper portion of the liver on right lateral projections of liver and liver-lung scans were found in two women whose ^{99m}Tc-sulfur colloid scans were performed with the patients supine. The defects were ultimately found to be artifactual due to pendulous breasts interposed between the side of the body and the gamma camera detector. (auth)

9021 RESOLUTION OF INCREASED SPLENIC SIZE AND UPTAKE OF ^{99m}Tc-SULFUR COLLOID FOLLOWING REMOVAL OF A MALIGNANT MELANOMA. Klingensmith, W. C. III. (Air Force Medical Center, Scott AFB, IL). J. Nucl. Med.; 15: No. 12, 1203-1204(Dec 1974).

Increased splenic uptake of ^{99m}Tc-sulfur colloid (TcSC) in patients with malignant melanoma and no evidence of liver disease was recently reported. In a similar patient serial liver-spleen studies demonstrated the resolution of splenomegaly and increased splenic uptake of TcSC following the surgical removal of a malignant melanoma of the eye. (auth)

9022 INTENSE UPTAKE OF ^{99m}Tc-DIPHOSPHONATE BY AN EXTRAOSSEOUS NEUROFIBROMA. Nolan, N. G. (Mayo Clinic and Mayo Foundation, Rochester, MN). J. Nucl. Med.; 15: No. 12, 1207-1208(Dec 1974).

Increasing experience in the use of ^{99m}Tc-phosphate complexes for bone scanning has brought to light several instances in which these agents have been concentrated by a number of pathologic entities having no known association with bone and not characterized by osteoblastic activity. In one patient, a skeletal scan was done because of previous diagnosis of adenocarcinoma of the prostate. Abnormal uptake was noted in the distal right thigh. Surgical exploration of the area revealed a mass buried in the sheath of the sciatic nerve. Histologic examination revealed that the lesion was a neurofibroma. Histologic evidence for calcification or ossification was not found. (auth)

9023 DISAPPEARANCE OF AUTONOMOUS THYROID NODULE UNDER TSH STIMULATION. Soin, J. S.; Beal, W.; Burdine, J. A. (Baylor Coll., Houston, TX). J. Nucl. Med.; 15: No. 12, 1209-1211(Dec 1974).

This report describes a case of an autonomous thyroid nodule that showed greatly decreased uptake of ^{99m}Tc-pertechnetate during scintiscanning following exogenous thyroid-stimulating hormone (TSH) administration whereas the previously suppressed thyroid parenchyma was clearly visualized. The cause of this phenomenon is not entirely clear. (auth)

9024 PREOPERATIVE LOCALIZATION OF AN INSULINOMA BY EXTERNAL SCANNING WITH ^{131}I-TOLUIDINE BLUE. Sparagana, M.; Veatch, R.; Supan, W.; Kaplan, E.; Paloyan, E. (Veterans Administration Hospital, Chicago). J. Nucl. Med.; 15: No. 12, 1212-1216(Dec 1974).

A new technique of external scanning with ^{131}I-toluidine blue-0 was used to localize an occult pancreatic islet cell adenoma in a patient. Although the subject showed good biochemical evidence of hyperinsulinism, no insulinoma was found at the initial thorough exploration. Severe hypoglycemia and hyperinsulinism persisted despite blind resection of 80% of the pancreas. Preoperative localization of the adenoma in the pancreatic remnant greatly facilitated its removal during re-exploration. (auth)

9025 DELAYED APPEARANCE OF ANTERIOR CEREBRAL ARTERIES ON ISOTOPIC CEREBRAL FLOW STUDY: A SIGN OF BLEEDING ANTERIOR COMMUNICATING ARTERY ANEURYSM. Stein, M. A.; Winter, J. (Univ. of California, Los Angeles). J. Nucl. Med.; 15: No. 12, 1217-1219(Dec 1974).

Delayed appearance of the anterior cerebral arteries on an ^{99m}Tc-pertechnetate cerebral flow study in association with a right frontal area of decreased activity was seen in a patient with a hemorrhage from a ruptured anterior communicating artery aneurysm. It is suggested that closer scrutiny of the major vessels, in addition to the usual grosser hemispheric observations, would prove this finding to be more frequent. The importance of making this observation of delayed appearance of a major vessel, particularly in conjunction with a hemispheric abnormality, is that it raises the suspicion of an aneurysm as the cause of the cerebral vascular accident. This suspicion alters the further evaluation and care of the typical stroke patient because a lesion potentially correctable by surgery may otherwise be overlooked. (auth)

9026 LUNG UPTAKE OF ^{99m}Tc-SULFUR COLLOID IN PATIENT EXHIBITING PRESENCE OF Al^{3+} IN PLASMA. Bobinet, D. D.; Sevrin, R.; Zurbriggen, M. T.; Spolter, L.; Cohen, M. B. (Veterans Administration Hospital, Sepulveda, CA). J. Nucl. Med.; 15: No. 12, 1220-1222(Dec 1974).

Moderate lung uptake of ^{99m}Tc-sulfur colloid was observed in a patient on hourly antacids who was found to have an elevated plasma aluminum level. A repeat scan 5 days after discontinuing antacids when the patient had only a slight increase in plasma aluminum level revealed minimal uptake in the lungs. (auth)

9027 KIT-PRODUCED ^{99m}Tc-LABELED RED CELLS FOR SPLEEN IMAGING. Gutkowski, R. F.; Dworkin, H. J. (William Beaumont Hospital, Royal Oak, MI). J. Nucl. Med.; 15: No. 12, 1187-1191(Dec 1974).

A new method for labeling autologous red blood cells (RBC) with ^{99m}Tc-pertechnetate is presented. RBC are pretreated with stannous glucoheptonate, then mixed with $^{99m}TcO_4^-$, and finally heat-damaged (H-D). The rapid splenic uptake and high spleen/liver ratio of ^{99m}Tc-H-D RBC yields good-quality spleen images by 30 min postdose. (auth)

9028 LOCALIZATION OF ^{133}Xe IN LIVER DURING VENTILATION STUDIES. Carey, J. E.; Purdy, J. M.; Moses, D. C. (Univ. of Michigan, Ann Arbor). J. Nucl. Med.; 15: No. 12, 1179-1181(Dec 1974).

A review of 52 consecutive ^{133}Xe ventilation studies yielded 20 cases (38%) with right upper-quadrant ^{133}Xe activity which was shown to be in liver. In eight of these cases, the activity was thought to affect the interpretation of ^{133}Xe clearance from the right lung base. The apparent retention of ^{133}Xe in liver may be due to position of the patient or to underlying liver disease. If ^{133}Xe washout serial scintiphotographs are to be used in the evaluation of lung ventilation, this potential interference must be considered when the images reveal impaired clearance from the right lung base. (auth)

9029 NONINVASIVE NUCLEAR KINECARDIOGRAPHY. Alpert, N. M.; McKusick, K. A.; Pohost, G. M.; Dinsmore, R. E.; Potsaid, M. S. (Massachusetts General Hospital, Boston). J. Nucl. Med.; 15: No. 12, 1182-1184(Dec 1974).

A kinecardiographic display was obtained with an Anger camera gated to the electrocardiogram of subjects receiving an intravenous injection of ^{99m}Tc-human serum albumin. (auth)

9030 EFFICACY OF SKULL IMAGING IN ROUTINE BONE SCANNING. Coleman, R. E.; Bernier, D. R.; Pasternak, S.;

Siegel, B. A. (Washington Univ., St. Louis). J. Nucl. Med.; 15: No. 12, 1185-1186(Dec 1974).

The frequency of abnormal skull images in patients undergoing ^{99m}Tc-Sn-diphosphonate bone imaging has been reviewed. In 181 patients with known malignant tumors, 47% had abnormal scans of the axial skeleton and 28% had abnormal skull images. Only 2 of these 181 patients had abnormal skull images and a normal scan of the axial skeleton. In 38 patients with benign disorders the skull image was abnormal in 6, all with Paget's disease. No patient with a benign disorder had skull involvement alone. (auth)

9031 RADIONUCLIDE IMAGING OF EXPERIMENTAL MYOCARDIAL CONTUSION. Go, R. T.; Chiu, C. L.; Doty, D. B.; Cheng, H. F.; Christie, J. H. (Univ. of Iowa, Iowa City). J. Nucl. Med.; 15: No. 12, 1174-1175(Dec 1974).

Localization of ^{99m}Tc-Sn-polyphosphate in injured myocardium following experimental myocardial contusion in dogs has been demonstrated. Imaging using this radiopharmaceutical agent to detect areas of myocardial damage should be a useful technique in clarifying the difficult clinical diagnosis of myocardial contusion following closed chest trauma in man. (auth)

9032 BONE SCAN IN PRIMARY HYPERPARATHYROIDISM. Sy, W. M. (Brooklyn Cumberland Medical Center). J. Nucl. Med.; 15: No. 12, 1089-1091(Dec 1974).

Four patients with primary hyperparathyroidism due to parathyroid adenoma, chief cell type, manifested some bone scan abnormalities not unlike the distribution of abnormally increased activity of dialysis patients with the secondary type. Bone scan using ^{99m}TcSn-polyphosphate or any of the newer ^{99m}Tc-labeled phosphates is recommended in patients with hypercalcemia or suspected hyperparathyroidism. (auth)

9033 NATURAL HISTORY OF NONSURGICALLY TREATED SUBDURAL HEMATOMA AS STUDIED BY RAPID-SEQUENCE SCINTIPHOTOGRAPHY. Lusins, J. L.; Katz, J. H. (Mount Sinai Hospital, New York). J. Nucl. Med.; 15: No. 12, 1084-1088(Dec 1974).

Rapid-sequence ^{99m}Tc-pertechnetate scintiphotography has been employed to follow the evolution of chronic and subacute subdural hematoma in six patients and was correlated with patient improvement, conventional radiologic angiography, and the static scan. The reliability of the scintiphotogram is greatly improved when the scintillation camera is interfaced with a digital computer capable of producing smoothed images, frame summation, and relative flow curves from selected regions of interest. (auth)

9034 ECONOMIC, SEMIAUTOMATIC METHOD FOR IN VITRO THYROID FUNCTION TESTS. Wong, P. Y.; Cradduck, T. D.; Wood, D. E. (Toronto General Hospital). J. Nucl. Med.; 15: No. 12, 1074-1077(Dec 1974).

Modified serum thyroxine and serum thyroid hormone binding-capacity assays using ^{125}I and ^{131}I as tracers are presented. These modifications permit significant economy without loss of accuracy or reproducibility. Kits are not purchased; rather specified quality control is imposed on all stages of the procedure from purchase and assay of the reagents through test performance to the analysis of the data produced. The resultant protocols permit a high-volume, low-cost laboratory operation that maintains appropriate laboratory proficiency. (auth)

9035 CLINICAL EVALUATION OF ^{99m}Tc-LABELED MONOFLUOROPHOSPHATE: A COMPARISON WITH ETHANEHYDROXY-DIPHOSPHONATE. Citrin, D. L.; Bessent, R. G.; Greig, W. R. (Royal Infirmary, Glasgow). J. Nucl. Med.; 15: No. 12, 1110-1112(Dec 1974).

In preliminary clinical studies a new bone scanning agent, ^{99m}Tc-labeled monofluorophosphate (MFP), provided satisfactory visualization of bone tumors. Comparison of MFP with EHDP shows, however, that because of higher tumor/bone ratios, lower blood activities, and more rapid whole-body excretion, EHDP remains the agent of choice at present. (auth)

9036 VALUE OF CEREBRAL ISOTOPE FLOW STUDIES IN TIMING OF SURGERY FOR RUPTURED ANEURYSMS WHEN THERE IS VASOSPASM AND NEUROLOGIC DEFICIT. Goodman, S. J.; Hayes, M. (Univ. of California, Los Angeles). J. Nucl. Med.; 15: No. 12, 1113-1116(Dec 1974).

There are a variety of guidelines concerning the timing of surgery for intracranial aneurysms when there has been aneurysmal rupture with subarachnoid hemorrhage. However, there are almost no guidelines regarding the timing of surgery when there is angiographic vasospasm. In the particular clinical situation when there is angiographic vasospasm and a focal neurologic deficit, a cerebral isotope flow study will reveal abnormalities in both the arterial and capillary phases. Furthermore, serial flow studies can be used to determine the resumption of a normal flow pattern and thus a safer time for intracranial surgery. Since a neurologic deficit may remain fixed because of brain infarction, clinical testing may be an inadequate method of determining focal cerebral blood flow. We recommend a combination of bedside exams, serial isotope flow studies, and interval angiograms as a good method for assessing cerebral blood flow after there has been subarachnoid hemorrhage, vasospasm, and a focal neurologic deficit. Two case reports in which ^{99m}Tc-pertechnetate brain scans were done, are indicative of our recent experience concerning eight patients. (auth)

9037 SCINTIGRAPHIC DETECTION OF DEEP-VEIN THROMBOSIS WITH ^{131}I-FIBRINOGEN. Charkes, N. D.; Dugan, M. A.; Maier, W. P.; Escovitz, E.; Learner, N.; Dubin, R.; Kozar, J. III. (Temple Univ., Philadelphia). J. Nucl. Med.; 15: No. 12, 1163-1166(Dec 1974).

Twenty-nine postoperative patients and 8 with fractured hip were injected with ^{131}I-fibrinogen and whole-body scintiscans made at frequent intervals for a week. Venography was performed in 20 of the patients and the concordance between the two studies was 93%. Deep-vein thrombi were found in eight postoperative patients (28%) and in three with fractured hip (38%). Scintiscanning with ^{131}I-fibrinogen has certain advantages over the ^{125}I-fibrinogen method including the possibility of detecting iliac-vein thrombi. (auth)

9038 COLD BONE LESIONS: A NEWLY RECOGNIZED PHENOMENON OF BONE IMAGING. Goergen, T. G.; Alazraki, N. P.; Halpern, S. E.; Heath, V.; Ashburn, W. L. (Veterans Administration Hospital, San Diego, CA). J. Nucl. Med.; 15: No. 12, 1120-1124(Dec 1974).

Cold (photon-deficient) bone scan lesions are reported in seven patients with a variety of disease processes including metastatic disease, post-traumatic aseptic necrosis, and sickle cell-C crisis. Patients were studied with ^{99m}Tc-polyphosphate and/or ^{18}F scans, and in two cases, ^{111}In-chloride bone marrow scans. Foci of decreased radioisotope activity were identified corresponding to sites of metastatic tumor and bone infarcts. Infarction may be a primary mechanism in the production of diminished radionuclide uptake in some of the cases. Consideration is given to a spectrum of abnormal bone-imaging manifestations (increased uptake, normal uptake, to photon-deficient as a useful concept in the interpretation and understanding of bone scans. (auth)

9039 ^{14}C-TRIPALMITIN BREATH TEST AS A DIAGNOSTIC AID FOR FAT MALABSORPTION DUE TO PANCREATIC INSUFFICIENCY. Chen, I. W.; Azmudeh, K.; Connell, A. M.; Saenger, E. L. (Univ. of Cincinnati). J. Nucl. Med.; 15: No. 12, 1125-1129(Dec 1974).

Specific radioactivity of expired $^{14}CO_2$ after ingestion of a test meal containing 5 μCi of ^{14}C-labeled tripalmitin was measured at 1-hr intervals for 8 hr and also at 24 hr. Two or more days later, the test was repeated with ten tablets of Viokase (containing 650 FIP units of lipase per tablet) given immediately after the ^{14}C-test meal. A mean peak specific radioactivity of expired $^{14}CO_2$ ($^{14}CO_2$ value, expressed as percent dose per millimole $\times 10^4$) without Viokase was 53.3 ± 3.3 (1 s.e.m.) for ten normal subjects and 25.8 ± 5.1 for 18 malabsorption patients. The test was repeated with Viokase in seven fat malabsorption patients with pancreatic involvement and fat malabsorption patients with no evidence of pancreatic involvement. The parameters examined were the absolute increase in the peak $^{14}CO_2$ value due to Viokase administration and the ratio of post-Viokase to pre-Viokase peak $^{14}CO_2$ values. Both parameters for the group with pancreatic involvement (the increase of 27.9 ± 3.4 and the ratio of 6.1 ± 1.7) were significantly greater than those for the group with no evidence of pancreatic involvement (5.2 ± 1.4 and 1.3 ± 0.1) ($p < 0.001$ and $p < 0.05$). In addition, six patients with diabetes mellitus (five with and one without steatorrhea) were studied. There was a delay in the appearance of $^{14}CO_2$ in breath and their mean peak $^{14}CO_2$ value was $53.1 < 6.7$. When the test was repeated with Viokase in three of the diabetic patients with steatorrhea, the delayed $^{14}CO_2$ expiration was restored to normal. The results suggest that the $^{14}CO_2$ values without and with Viokase administration are of value in differential diagnosis of pancreatic malabsorption in patients without diabetes. (auth)

9040 BRAIN IMAGING WITH ^{99m}Tc-DPTA: A CLINICAL COMPARISON OF EARLY AND DELAYED STUDIES. Wolfstein, R. S.; Tanasescu, D.; Sakimura, I. T.; Waxman, A. D.; Siemsen, J. K. (Cedars of Lebanon Hospital, Los Angeles). J. Nucl. Med.; 15: No. 12, 1135-1137(Dec 1974).

One hundred and twenty-six patients had a total of 129 brain studied performed 30 to 60 min and repeated 3 to 5 hr following intravenous injection of ^{99m}Tc-DTPA. Fifty-one abnormal studies showed 55 lesions. Twenty-seven percent of lesions could not be identified in early imaging but were clearly seen in delayed studies. An additional 35% of lesions had significantly improved visualization with delayed imaging. (auth)

9041 STERILITY TESTING OF RADIOPHARMACEUTICALS. Chen, M.; Rhodes, B. A.; Larson, S. M.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). J. Nucl. Med.; 15: No. 12, 1142-1144(Dec 1974).

A radiometric method for sterility testing of radiopharmaceuticals was developed. This technique is rapid and sensitive and may be used for sterility testing of both ^{99m}Tc-labeled compounds and nonradioactive kit components. The method is based on the monitoring of $^{14}CO_2$ released from viable bacteria in growth media containing ^{14}C-labeled substrates. (CH)

9042 RAPID AUTOMATED SYSTEM FOR MEASUREMENT OF ANTIBODY TITERS. Amrein, P. C.; Larson, S. M.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). J. Nucl. Med.; 15: No. 12, 1145-1148(Dec 1974).

An automated radiometric system based on measurements of ^{14}C-glucose conversion to $^{14}CO_2$ originally developed for detection of microbial growth has been adapted for measurement of antibody titers in sera. Immune sera could be detected in dilutions of 1:10,000, which is well below the range of complement fixation techniques and above the usual range for radioimmunoassay. The technique is based on the principle that polymorphonuclear leukocyte metabolism is altered by the end products of immunoreactions, and that these changes in metabolism are quantitatively related to the concentration of antigen and antibody in the medium. Results support the concept that induced changes in leukocyte metabolism can be used as a rapid and sensitive technique for making serologic measurements on biologic fluids. (auth)

9043 RADIONUCLIDE BREAST SCANNING IN CARCINOMA OF THE BREAST. Serafini, A. N.; Raskin, M. M.; Zand, L. C.; Watson, D. D. (Univ. of Miami, Miami Beach, FL). J. Nucl. Med.; 15: No. 12, 1149-1152(Dec 1974).

Radionuclide breast scans using ^{99m}Tc-polyphosphate and ^{99m}Tc-diphosphonate have been found to be positive in a high percentage of patients with carcinoma of the breast. This may be useful in providing independent corroboration in conjunction with other presently performed preoperative tests. (auth)

9044 USE OF SCALER ATTACHMENT TO RECTILINEAR SCANNER TO MEASURE ^{99m}Tc-PERTECHNETATE UPTAKE BY THE THYROID: CLINICAL STUDIES. Leeper, R. D.; Powell, M.; Benua, R. S. (Sloan-Kettering Memorial Cancer Center, New York). J. Nucl. Med.; 15: No. 12, 1117-1119(Dec 1974).

A simplified method for measuring the thyroidal uptake of ^{99m}Tc-pertechnetate was used to study 60 patients with normal and abnormal thyroid function. Output from the pulse-height analyzer of a single-headed rectilinear scanner was fed to a scaler and various areas of a thyroid scan could then be counted for background subtraction purposes. The ^{99m}Tc-pertechnetate uptake range in 47 euthyroid individuals was 0.4 to 3.5%, which is similar to the range obtained by more complex γ camera methods. The described method utilizes relatively inexpensive and easily available equipment, allows for simultaneous optimum imaging conditions, eliminates tedious dot counting, and is as rapid as γ camera methods. (auth)

9045 CURRENT STATUS OF DIAGNOSTIC COUNTING AND IMAGING TECHNIQUES USED IN NUCLEAR MEDICINE: A SKETCH. Beck, R. N. (Univ. of Chicago). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 2, 15-32(Apr 1974).

Diagnostic procedures used in Nuclear Medicine are designed to to provide information about the static and/or dynamic distribution of some particular stable or radioactive material within the patient, as well as the quantity of the material present. Thus, the static distribution of ^{131}I in the thyroid indicates the structure of the gland, whereas changes in the distribution or in the quantity present indicate its rate of functioning. A remarkable variety of techniques, based on emission, transmission, fluorescence, and incoherent holographic imaging principles, have been developed. Both moving and fixed radiation detectors are used, and these produce planar and 3-D projections and transverse sections of the object of interest. In general, the image quality is determined by detector characteristics such as sensitivity, spatial resolution, and depth of field, as well as by the examination time, object contrast, and object intensity, which is always severely limited in the interest of a low radiation dose to the patient. Image processing techniques can be used to improve image quality by removing certain artifacts and by producing a degree of sharpening that is limited by the signal-to-noise ratio. Incoherent holography and optimum-weighted multichannel imaging are presented as two approaches to increasing the signal-to-noise ratio. Alternative criteria for the evaluation of imaging procedures are presented, with an emphasis on the use of ROC curves to describe observer performance. (auth)

9046 RADIOIMMUNOASSAY FOR HUMAN PROCOLLAGEN. Taubman, M. B. (New York Univ., NY); Goldberg, B.; Sherr, C. J. Science; 186: No. 4169, 1115-1117(Dec 1974).

Rabbit antiserums were produced against the procollagen molecule secreted into the medium of cultured human skin fibroblasts. The isolated antigenic, amino terminal portion of the procollagen molecule was purified, labeled with iodine-125, and used in a radioimmunoassay which detected nanogram quantities of the same antigen. With the assay, immunologically identical molecules were detected in the culture medium of different strains of human fibroblasts and in normal human serums. Serums from human cord blood contained a 12-fold higher concentration of the antigen than serums from adults, while serums from other vertebrates gave reactions to incomplete cross-reactivity or nonreactivity. (auth)

9047 RADIOISOTOPE TECHNIQUE FOR ESTIMATING LADY BEETLE CONSUMPTION OF TOBACCO BUDWORM EGGS AND LARVAE. Moore, S. T.; Schuster, M. F.; Harris, F. A. (Mississippi State Univ., State College). J. Econ. Entomol.; 67: No. 6, 703-705(16 Dec 1974).

Females of the tobacco budworm, Heliothis virescens (F.), were fed Phosphorus-32 (in $NaH_2{}^{32}PO_4$) in a 10% sucrose solution. Eggs and larvae of the moths were assayed for radioactivity before feeding them to the adult lady beetles, Coleomegilla maculata DeGeer. The adults were assayed for radioactivity each day for 10 days after consumption of the eggs or larvae. Radioactivity levels in the lady beetles showed a gradual decline each day after consumption of egg or larvae. Prediction equations from regression analysis indicate that the number of eggs or larvae eaten by adult C. maculata can be predicted in laboratory or field studies after determining radioactivity of H. virescens eggs or larvae prior to lady beetle consumption. (auth)

9048 CHOLESTEROL ABSORPTION IN PRIMATES AS DETERMINED BY THE ZILVERSMIT ISOTOPE RATIO METHOD. Kritchevsky, D.; Winter, P. A. D.; Davidson, L. M. (Wistar Inst. of Anatomy and Biology, Philadelphia). Proc. Soc. Exp. Biol. Med.; 147: No. 2, 464-466(Nov 1974).

The Zilversmit isotope ratio method for measuring cholesterol absorption has been applied to baboons (Papio ursinus) and vervet monkeys (cercopithecus aethiops pygerethrus) and found to compare well with the more complicated method involving fecal excretion. Cholesterol absorption in the baboon was found to be 26.3% by the Zilversmit method and 22.2% by the fecal excretion method. In vervet monkeys the Zilversmit method showed 26.9% absorption as compared with 29.1% by the other. Sitosterol degradation (which is used to assay degradation) was found to be 64.1 and 69.3% in monkeys and baboons, respectively. Sitosterol degradation is about 5% in rats and 23 to 27% in man. The correction for sterol degradation must, therefore, be determined for each species (and possibly in each experiment). (auth)

9049 MEASUREMENT OF RED BLOOD CELL LIFE-SPAN. Brouillard, R. P. (Walter Reed Army Medical Center, Washington, DC). J. Amer. Med. Ass.; 230: No. 9, 1304-1305 (2 Dec 1974).

The life-span of the red blood cell (RBC) is difficult to estimate clinically, as hemolysis may exist in the presence of normal levels of hemoglobin and bilirubin, as well as normal reticulocyte counts. Clinically useful methods for quantification of the RBC life-span include isotope methods and measurement of endogenous carbon monoxide production. Chromium-51 is the isotope most widely used but has the disadvantage of requiring blood sampling for 30 days. Measurement of endogenous carbon monoxide production has the advantage of sensitivity to low-grade hemolysis and requires only three hours of the patient's time. It is potentially useful for demonstrating changing levels of hemolysis related to drug therapy or autoimmune states. (auth)

9050 TUMOR AND SKELETAL IMAGING IN BONE CARCINOMA: AN EXPERIMENTAL DEMONSTRATION. Okuyama, S.; Ito, Y.; Sato, T.; Takahashi, K.; Matsuzawa, T. (Tohoku Univ., Sendai). Radiology; 113: No. 3, 681-685(Dec 1974).

Radiostrontium ^{85}Sr-chloride and ^{99m}Tc-pyrophosphate accumulated in bone reacting to tumor invasion but not in the experimental bone tumor itself. Both ^{67}Ga-and ^{99m}Tc-bleomycin were concentrated in the tumor as well as in the reacting bone. This discrimination of tumor affinity from skeletal delineation was illustrated by radioisotopic imaging in rabbits. The finding appears to imply that scanning with ^{67}Ga-and ^{99m}Tc-bleomycin would be of help in early diagnosis of bone metastases and in delimiting fields of surgery and teletherapy in the absence of detectable radiographic abnormalities. (auth)

9051 STATISTICAL CONSIDERATIONS IN LUNG IMAGING WITH ^{99m}Tc ALBUMIN PARTICLES. Heck, L. L.; Duley, J. W. Jr. (Methodist Hospital, Indianapolis). Radiology; 113: No. 3, 675-679(Dec 1974).

Two patients were studied with serial lung imaging following the injection of increasing numbers of ^{99m}Tc-labeled albumin microspheres to determine the number of particles required to give satisfactory lung images. Definite scan abnormalities were observed when less than 15,000 particles were injected. However, in view of the many imaging variables and the inability to inject all particles in the syringe, it is recommended that one administer a minimum of 60,000 albumin microspheres. This will avoid false positive scans resulting from an insufficient number of particles when using currently available instrumentation. (auth)

9052 RADIOIMMUNOASSAY FOR PHENOBARBITAL. Satoh, H.; Kuroiwa, Y.; Hamada, A.; Uematsu, T. (Showa Univ., Tokyo). J. Biochem. (Tokyo).; 75: No. 6, 1301-1306(Jun 1974).

A radioimmunoassay for phenobarbital was investigated. Antiphenobarbital antisera were obtained by single immunization or repeated immunization of rabbits with p-azophenobarbital protein. The conditions for radioimmunoassay using ^{14}C-phenobarbital (specific activity 3.15 mCi/mmole) and ^{3}H-phenobarbital (specific activity 10.3 Ci/mmole) are described. Eighty picograms of phenobarbital could be detected by this technique. The determination of serum phenobarbital concentration in the mouse after intraperitoneal administration was carried out. (auth)

9053 COMPARATIVE EVALUATION OF ^{32}P TRACER STUDY AND MAMMOGRAPHY FOR DIAGNOSIS OF BREAST NEOPLASMS. Miclutia, M.; Holan, T. Radiobiol.-Radiother.; 15: No. 3, 391-398(1974). (In Rumanian).

The diagnostic value of ^{32}P uptake tests (TRFC) was studied on 87 patients and the advantages when compared with routine radiographic mammography were studied on 60 patients. In contrast to other works, the studies were made on incipient malignant lesions. It was concluded that in these conditions TRFC has a relative low value in the diagnosis of incipient neoplasms. The combined use of TRFC and mammography yields a morpho-functional profile of the mammary gland and the diagnostic results are improved greatly. (tr-auth)

9054 ANTIBODY RESPONSE TO MYELIN BASIC PROTEIN IN LEWIS AND FISCHER RATS AS FOLLOWED BY A SODIUM SULFATE METHOD OF RADIOIMMUNOASSAY. Day, E. D.; Wexler, M. A. (Duke Univ. Medical Center, Durham, NC). J. Immunol.; 113: No. 6, 1952-1957(Dec 1974).

The sodium sulfate method of radioimmunoassay of ^{125}I-labeled myelin basic protein could be used in the measurement and linear regression analysis of myelin-basic protein-binding activity in Lewis and Fischer rats, and could be adapted to the day-to-day single point measurements of antibody in microliter quantities of serum without untoward loss of statistical precision. (auth)

9055 ANTIBODY RESPONSE TO MYELIN BASIC PROTEIN (BP) IN LEWIS RATS: THE EFFECT OF TIME, DOSAGE OF BP, AND DOSAGE OF MYCOBACTERIUM BUTYRICUM. Day, E. D.; Pitts, O. M. (Duke Univ. Medical Center, Durham, NC). J. Immunol.; 113: No. 6, 1958-1967(Dec 1974).

Through the use of a sodium sulfate method of radioimmunoassay the influence of variables such as the dosage of myelin basic protein (BP), the dosage of Mycobacterium butyricum, and the presence or absence of Bordetella pertussis was studied with reference to time of appearance and final level of anti-BP antibody in Lewis rats. Animals injected with constant amounts of mycobacteria (250 μg) and variable amounts of BP (2 to 50 μg) in Freund's complete adjuvant showed antibody levels which were proportional to the dosage of BP injected. The appearance of experimental allergic encephalomyelitis (EAE) could not be correlated with antibody level. When doses of BP were held constant (2.5 μg) while doses of injected mycobacteria were varied (5 to 500 μg), animals receiving higher amounts of mycobacteria developed antibody later and at lower levels than animals receiving an intermediate dosage of 50 μg. Parameters found to have very little influence upon antibody levels were the administration of 6.4×10^9 B. pertussis organisms as an ancillary adjuvant and the frequency of animal bleeding. Mycobacteria control injections in complete Freund's adjuvant without BP were shown to induce anti-BP antibody formation above normal, particularly at lower doses, but adsorption studies showed no evidence for BP-mycobacteria cross-reactivity. (auth)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 8308, 8309, 9166, 9269, 10257, 10266, 10359, 10382, and 10385–10387.

9056 (AAEC/E-300) PRODUCTION OF SINTERABLE URANIUM DIOXIDE FROM AMMONIUM DIURANATE. Part II. Batch Production in a Pulsed Fluidised Bed Reactor. Fane, A. G.; Le Page, A. H.; Alfredson, P. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1974. 56p. Dep. NTIS (US Sales Only) $6.00.

The development of a 0.13-m dia reactor is described. Both consecutive calcination and reduction (simple-batch operation) and simultaneous calcination and reduction (batch-continuous operation) were investigated. Sinterable UO_2, giving pellet densities in excess of 10.6 g cm^{-3} after sintering at 1600°C in H_2 for 4 h, was produced in both modes. The surface area of the UO_2 powder decreased with reduction in temperature; operating temperatures were typically 620 to 630°C for simple-batch operation, and 670 to 700°C for batch-continuous operation, to produce powders (4 to 6 m^2g^{-1}). Product characteristics were relatively insensitive to changes in the other operating variables. Satisfactory powders were produced by simple-batch operation with a H_2 concentration of 25 vol %, gas flow rates from 0.95 to 1.9 l s^{-1}, pulse frequencies of 0.5 to 0.75 Hz, pulse chamber volumes of 2.8 and 11.3 l, and either hot or cold charging of ADU. The maximum bed of ADU handled satisfactorily with simple-batch operation was 7 kg, resulting in a max throughput of 5 to 6 kg h^{-1} UO_2. For batch-continuous operation, satisfactory powders were produced with H_2 concentrations from 15 to 75 vol %, gas flow rates from 0.95 to 1.4 l s^{-1}, pulse frequencies of 0.5 and 0.75 Hz, a pulse chamber volume of 2.8 l, rates of feeding ADU from 7 to 20 kg h^{-1}, and bed depth-to-dia ratios of 3 to 7. An overall throughput of 12 kg h^{-1} of UO_2 was demonstrated using the batch-continuous mode of operation. H_2 consumption for both modes of operation was in the range 70 to 85% of input. Stabilization was readily carried out as a simple-batch operation in a pulsed fluidized bed stabilizer, using 10 vol % air in nitrogen and a temperature of about 50°C. The solids handling systems, which included pneumatic, vibratory and screw conveying, are also described. (9 tables, 19 figures) (DLC)

9057 (AAEC/E-329) SURFACE AREA CHANGES DURING THE CALCINATION OF AMMONIUM URANATE. Woolfrey, J. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

Changes during calcination of AU in various atmospheres were studied using constant rate of heating, isothermal, and isochronal experiments. X-ray diffraction, thermogravimetric analysis (TGA) and differential thermal analysis (DTA) were used to correlate these changes with the stages of reaction. During dehydration (20 to 200°C), AU "Type II" remains the major phase. Thermal decomposition (200 to 350°C) produces amorphous UO_3 and β-UO_3 which retain ammonia in their structure. These are subsequently converted to U_3O_8 by a self-reduction process (350 to 450°C). Reduction in a hydrogen atmosphere takes place between 450 and 510°C to produce UO_2. In an inert gas or air atmosphere, β-UO_3 and $UO_{2.9}$ persist to much higher temperatures, and the presence of an oxidizing atmosphere may completely eliminate the self-reduction reaction. The specific surface area increases during dehydration and decomposition and reaches a maximum between 400 and 450°C. The major increase in the surface area is attributed to the opening up of internal porosity, formed during decomposition, by stress-induced cracking of the particles. The internal stresses are generated by the nucleation and growth of phases which have different specific volumes from that of the parent solid. The maximum surface area was observed if self-reduction occurred. The decrease in specific surface area at higher temperatures is due to sintering. (7 figures, 4 tables) (auth)

9058 (AERE-M-2643) MECHANICAL PROPERTIES AND DIFFUSION DATA FOR CARBIDE AND OXIDE FUELS. Ceramics Data Manual Contribution. Matthews, J. R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1974. 49p. Dep. NTIS (US Sales Only) $5.50. UK £ 1.00 net.

Experimental results on elastic moduli, fracture, diffusion, thermal creep, and irradiation creep are reviewed and correlated using either physical models or an empirical expression. The resulting equations are restated in a list of recommended values for use in reactor fuel calculations together with an indication of their ranges of applicability and their certainty. (21 figures, 75 references) (auth)

9059 (COO-1441-24) ELECTRONIC CONDUCTION IN OXIDES AT ELEVATED TEMPERATURES. Blumenthal, R. N. (Marquette Univ., Milwaukee, Wis. (USA). Coll. of Engineering). 1974. 31p. (CONF-740573-1). Dep. NTIS $4.75.

From conference on electronic properties of oxides/applications and science; Lafayette, Indiana, USA (29 May 1974).

A brief discussion of the defect models and experimental techniques used to characterize the electrical conductivity of insulating and semiconducting oxides are presented. Emphasis is on the electronic conduction at elevated temperatures, where the oxide may be equilibrated with the ambient atmosphere. Typical examples of oxides are selected to emphasize (1) how information about defect structures and transport properties of the defects in oxides may be obtained from a combined analysis of different types of experimental data, and (2) some of the experimental and theoretical problems which are limiting our understanding of the electronic conductivity of insulating and semiconducting oxides and their application of technology. (11 fig, 39 references) (auth)

9060 (HEDL-TME-72-34) IRRADIATION OF BORON CARBIDE AND TANTALUM IN A SPECTRUM-HARDENED ETR FLUX. Pitner, A. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1972. Contract AT(45-1)-2170. 38p. AT.

Boron carbide pellets were irradiated at 1300 to 1900°F to a maximum burnup of 9×10^{20} captures/cc in a spectrum-hardened ETR flux to simulate LMFBR conditions. Although overheating caused instrumentation failure and resulted in early discharge of the test, the experimental design was shown to be basically sound and has been used successfully in a follow-on experiment. Samples retrieved from the test were in good physical condition and showed little microstructural damage. Data are reported for gas release, swelling, interaction with Type 316 stainless steel, and thermal conductivity change. Several specimens of tantalum were also irradiated to investigate swelling behavior. (6 tables, 16 figs.) (auth)

9061 (KFK-2038) DETERMINATION OF INTERFACIAL ENERGIES FOR OXIDE-METAL COMBINATIONS. Nikolopoulos, P. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Aug 1974. 117p. (In German). Dep. NTIS (US Sales Only) $9.00.

Thesis. Submitted to Karlsruhe Univ. (TH) (West Germany). Fakultaet fuer Maschinenbau.

Surface and grain boundary energies of stoichiometric UO_2 were determined at 1500, 1750, and 1900°C. Linear temperature functions were obtained by extrapolation for both quantities between zero and mp. Measurements of the interfacial energy of UO_2 with Ni yielded a linear development with the temperature for $T > T_{Ni}$ (T_{Ni} = mp of Ni). Includning literature data on interfacial energies between UO_2 and other liquid metals, it was shown that the relation for Ni can be extended to all combinations of UO_2 with liquid metals: $\gamma_{sl} = \gamma_{slm} + K\,(T - T_m)$, where $\gamma_{slm} = 1700 \pm 60$ erg/cm^2 at the mp, K = −1.4 erg cm^2-degree, T = temperature in °C, and T_m = the mp in °C. For other oxides, the interfacial energies are also linear. The relation between $d\gamma_{sl}/dT$ and the ion radius of the oxide-forming metal is discussed. Interfacial energies were determined between UO_2 and solid Cr, Mo, and V, in order to estimate the strength of the phase boundary. (40 figs., 97 references) (auth)

9062 (KFK-2039) TaC–HfC-CARBIDES AND TaC–HfC-CEMENTED CARBIDES. Scholz, B. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Sep 1974. 130p. (In German). Dep. NTIS (US Sales Only) $9.50.

Thesis. Submitted to Karlsruhe Univ. (TH) (West Germany). Fakultaet fuer Maschinenbau.

TaC_{1-x}, $(Ta_{0.8}Hf_{0.2})C_{1-x}$, $(Ta_{0.6}Hf_{0.4})C_{1-x}$, $(Ta_{0.4}Hf_{0.6})C_{1-x}$, and $(Ta_{0.2}Hf_{0.8})C_{1-x}$ and HfC_{1-x} can be prepared by melting and hot-pressing. Densities above 95% TD were reached by hot-pressing. Lattice constants were determined and the phase boundaries of $(TaHf)C_{1-x}$ were estimated. The highest hardness values at 20°C (MHV ~ 2900 kp/mm^2) and higher temperatures were found in nonstoichiometric mixed carbides. Wetting measurements were carried out by using the sessile-drop-method. Angles of contact of Co and Ni on single carbides are small, but they increase on the mixed carbides. In practice the carbides were embedded in binder phases: Substoichiometric carbides with a high concentration of defects in the C-lattice react with Co and Ni by formation of new intermetallic phases. The following nonstoichiometric carbides show no reaction: TaC_x-Co ($x \leq 0.92$), TaC_x-Ni ($x \leq 0.82$). All nonstoichiometric carbides react with the binder metals, if Ta carbide is partly or completely substituted by Hf carbide. TaC, HfC, and their mixed carbides were hot-pressed by using 5 different binder phases (5 wt %): Co, Ni, two alloys with high temperature strength (Co alloy, Ni alloy), and austenitic Cr–Ni steel. All cemented carbides investigated show hardness values at high temperatures similar to these of the corresponding carbides. Oxidation of the cemented carbides in air shows a weight gain proportional to time. Cemented carbides with mixed carbides show a better oxidation resistance than cemented carbides with TaC or HfC. (38 references, 59 figures, 7 tables) (auth)

9063 (LBL-2599) DETERMINATION OF PHASE DIAGRAMS USING DIFFUSION TECHNIQUES. Pask, J. A.; Aksay, I. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1974. 25p. (CONF-740672-1). Dep. NTIS $4.25.

From conference on ceramic science transport phenomena in ceramics; Cleveland, Ohio, USA (3 Jun 1974).

Semi-infinite diffusion couple arrangements between two condensed phases can be readily analyzed with the use of the electron beam microprobe analyzer to determine the composition profiles in the two end phases of the couple arrangement and in any intermediate phases that may grow between the end phases. When the reactions at the interfaces are diffusion controlled, chemical equilibrium exists at each interface and each interfacial composition then corresponds to either a liquidus or a solidus composition, and these interfacial compositions, with the aid of microstructural observations, can be used in the construction of the stable and/or metastable equilibrium phase diagrams involving the end phases of the diffusion couple. This technique is applied to the study of phase equilibria in the SiO_2–Al_2O_3 system. (5 fig) (auth)

9064 (RDT-C-18-1T(08-74)) CERAMIC ELECTRICAL INSULATORS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Aug 1974. 18p. RSO.

Requirements are given for ceramic electrical insulators to be used for high-temperature instrument application. Compositions and methods for conditioning the insulators and determining bulk density are presented. (DLC)

9065 DIRECT MEASUREMENT OF CURRENT–PHASE RELATIONS IN SUPERCONDUCTING WEAK LINKS. Jackel, L.D.; Buhrman, R.A.; Webb, W.W. (School of Applied and Engineering Physics, and Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14850). Phys. Rev. B 10: No. 7, 2782-2785 (1 Oct 1974).

We report a method for the direct measurement of the current–phase $i(\theta)$ relations in superconducting weak links. We show that by proper choice of experimental parameters, an accurate measurement of $i(\theta)$ can be obtained in spite of obscuring effects of thermal fluctuations. This method has been used to obtain the current–phase relation of an oxidized niobium point contact and has shown that it conforms closely to the sinusoidal Josephson relation. (auth)

9066 LOW TEMPERATURE MAGNETIC SUSCEPTIBILITY OF URANIUM AND RARE EARTH TUNGSTEN OXIDE BRONZES. Thomas, J.F.; Sienko, M.J. (Baker Laboratory of Chemistry, Cornell University, Ithaca, New York 14850). J. Chem. Phys. 61: No. 10, 3920-3924 (15 Nov 1974).

Magnetic susceptibilities of uranium tungsten bronzes, U_xWO_3, and their thorium–diluted counterparts, $U_xTh_{0.10-x}WO_3$, have been measured by the Faraday method over the range 1.6–300°K. The sharp, dilution–independent antiferromagnetic behavior previously reported was not confirmed. Weiss constants observed showed a weak decline with dilution. Susceptibilities of light rare earth bronzes (RE=Pr, Nd) deviated at low temperatures from Curie–Weiss behavior, probably because of changes in population of intra–atomic levels. For the heavy rare earth bronzes (RE=Gd, Tb, Dy, Ho, Er), very small Weiss constants were observed. Near independence of the Weiss constants of conduction electron density and rare earth magnetic content suggests that the apparent Curie–Weiss behavior is mainly a manifestation of crystal field interactions, not an indication of magnetic exchange effects. (auth)

9067 EFFECT OF SHOCK WAVES ON REFRACTORY COMPOUNDS. Communication IV. Zirconium Carbides. Anan'in, A. V.; Breusov, O. N.; Dremin, A. N.; Ivanova, V. B.; Pershin, S. V.; Tatsii, V. F.; Fekhretdinov, F. A. (Inst. of Modern Chemistry Problems, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 100-104(Oct 1974). (In Russian).

The effect of shock waves with an amplitude to 350 kbar was studied on technical zirconium carbide powder. The plast-treated powder differs essentially from the starting ones in the granulometric composition, defect degree, pycnometric density, specific surface, bulk weight, and spillage weight. It is shown that a preliminary shock-wave treatment of zirconium carbide produces cakes with a relative density of 80% at 2100°C whereas the starting monocarbide may be sintered to such a density only at 2500°C. (5 figures) (auth)

9068 STRUCTURAL PECULIARITIES IN FORMATION OF TWO-PLY PLASMIC COATINGS. Chevela, O. B.; Orlova, L. M. Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 48-54(Oct 1974). (In Russian).

Two-ply coatings of tungsten–zirconium dioxide on steel Kh18N10T backings and titanium alloy OT4 were studied. Application of the zirconium dioxide coating is shown to have an influence on the sublayer and backing. Conditions are substantiated and chosen for applying the zirconium dioxide plasmic coating. (7 figures) (auth)

9069 THERMOEMISSION OF REFRACTORY COMPOUNDS AND MATERIALS MADE FROM THEM. Samsonov, G. V.; Fomenko, V. S.; Podchernyaeva, I. A.; Okhremchuk, L. N. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 74-82(Oct 1974). (In Russian).

An analysis was made of the concentration dependence of the effective work function for different classes of refractory compounds (carbides, borides, and silicides of the transition metals of the IV-VI groups) both in regions of homogeneity and for different phases. On the basis of the comparison of these data with the concentration dependence of the hardness properties of the compounds (microhardness, fusion temperature, thermal expansion coefficient, etc.), reflecting the character of the interatomic interactions, it was shown that the surface layers of the crystals yield information on the electronic structure of the solids which determines the electron position in these layers. (tr-auth)

9070 ELECTRIC AND HEAT CONDUCTIVITY OF CERTAIN RARE-EARTH TETRABORIDES. Severyanina, E. N.; Dudnik, E. M.; Paderno, Yu. B. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 83-85(Oct 1974). (In Russian).

Electric conductivity of Y, Gd, Tb, Er, Tm, Ho, and Dy tetraborides at 300 to 1000° K and their thermal conductivity at room temperature were studied. The conductivity of all the tetraborides is of the metal type. Their resistance at indoor temperature is approximately the same and less than in pure metals. Electronic and phonon components of MeB_4 thermal conductivity are higher than the corresponding values of metals. (auth)

9071 INVESTIGATION OF PRODUCTION TECHNIQUE FOR GAS-POWDER BORON CARBIDE DEPOSITION. Dobrovolskii, A. G.; Lebedev, V. P.; Kovalenko, A. A. (Kiev Engineering-Construction Inst.). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 42-47(Oct 1974). (In Russian).

Factors in gas-powder B_4C deposition are investigated: the powder granularity, thickness of the layer and depth of penetration, effect of the shape on quality of the deposited layer, deposition rate. Powder granularity No. 10–16 is determined to be optimal for deposition. Deposition of only B_4C does not permit coatings thicker than 1 mm. For thicker layers, powder mixtures of 50–75% B_4C– Fe should be used. An empirical formula is given for the coating thicknesses as a function of B_4C content. The method is meant for obtaining coatings chiefly on flat surfaces of small parts. (auth)

9072 REGULARITIES OF NIOBIUM CARBIDE SINTERING. Kindysheva, V. S.; Kislyi, P. S. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 29-32 (Oct 1974). (In Russian).

Kinetics of the niobium carbide sintering process is investigated. Sintering of niobium carbide with iron admixtures and treated with muriatic acid is studied. The experimental results show that prolonged grinding and the presence of iron activate the sintering process. (5 figures) (auth)

9073 ACCUMULATION AND RADIATION CONVERSION OF A NUMBER OF RADIATION-SIMULATED CENTERS ASSOCIATED WITH Ge IN CRYSTALLINE QUARTZ. Ikramov, G. (Samarkand State Teacher's Inst., USSR). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 71-73(1974). (In Russian).

Ionizing radiation creates various radiation-stimulated centers which are a function of the nature of activators present in crystalline quartz. These centers differ from each other by many physical properties which include the type of accumulation as modified by irradiation and possible radiation annealing. Independent centers belonging to impurities of Al and Ge can be observed in irradiated quartz. The optical absorption saturation of radiation-induced color centers of a dark hue differs substantially in quartz containing impurities of Ge and without Ge being present. Differential equations are derived and solved to explain this anomalous behaviour in quartz containing Ge and Al color centers which decay at different rates under irradiation. (SJR)

9074 REACTION OF Al_2O_3–2 WT. % MgO PROTECTIVE COATINGS WITH A BeO SUBSTRATE. III. Further Observations.

Reeve, K. D.; Napier, J. G.; Webb, C. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sydney). J. Aust. Ceram. Soc.; 10: No. 1, 22-24(May 1974).

Two protective coatings (Al_2O_3 and Al_2O_3 containing 2% MgO) were annealed onto a BeO substrate to determine the role of MgO in the sequence of phases in the reaction layer. In the absence of an applied pressure, the $BeO-Al_2O_3$ bond for the BeO/Al_2O_3 system fails as readily as the reaction occurs, and the two product phases are $BeO.Al_2O_3$ and $BeO.3Al_2O_3$. The reaction layer of the Al_2O_3-MgO/BeO system was more complicated. (AT)

9075 MELTING POINT OF Y_2O_3 IN VACUUM. Jones, T. P. (National Standards Lab., Sydney). J. Aust. Ceram. Soc.; 10: No. 1, 21-22(May 1974).

A description is given of the experimental techniques used to obtain the melting point of yttria. All temperatures stated are expressed in terms of IPTS 68. The melting point obtained was 2446°C ± 6°C. (AT)

9076 NEUTRON DIFFRACTION MEASUREMENT OF DIFFUSE SCATTERING IN $VC_{0.75}$. Sauvage, M. (Univ., Geneva); Parthe, E.; Yelon, W. B. Acta Crystallogr., Sect. A; 30: No. 4, 597-599(1 Jul 1974).

The location of diffuse intensity originally observed in electron diffraction patterns of short-range-ordered $VC_{0.75}$, was confirmed by neutron diffraction experiments on a four-circle diffractometer. A new set of short-range order parameters was calculated on the basis of these accurate intensity data and the agreement between experimental results and theoretical predictions for short-range-ordered compounds with NaCl related structure was improved. (auth)

9077 ATOMIC ORDERING AND LATTICE DISTORTION IN THE ZIRCONIUM-OXYGEN ALLOYS WITH 28.2 AND 29.2 AT. % OXYGEN. Hashimoto, S.; Iwasaki, M.; Ogawa, S.; Yamaguchi, S.; Hirabayashi, M. (Tohoku Univ., Sendai). J. Appl. Crystallogr.; 7: No. 1, 67-73(1 Feb 1974).

The structure of the interstitially ordered lattice formed in Zr−O alloys was studied with single-crystal data from x-ray and neutron diffraction methods. The structure belongs to space group P312 and the lattice parameters a and c are related to a_0 and c_0 of the host hexagonal metal lattice by $a = \sqrt{3}a_0$ and $c = c_0$. The ordered arrangement of interstitial oxygen atoms is described as a regular stacking of layers parallel to the (00.1) plane with the sequence (AC)B(AC)B ..., which is of the same type as that of nitrogen atoms in $\epsilon-Fe_2N$. The occupancy probability of oxygen atoms is high for interstitial sites of the A and B types while it is low for sites of the C type. The host metal lattice is distorted in such a way that spacings of successive (00.2) planes are not the same and a hexagonal network of atoms in these planes is periodically deformed. (auth)

9078 ELECTRON MICROSCOPIC STUDY OF THIN LAYERS OF THE MIXED RARE EARTH SESQUIOXIDES 90% Nd_2O_3−10% Y_2O_3. Loier, C. (CNRS, Bellevue, France); Caro, P.; Portier, R.; Fayard, M. Mater. Res. Bull.; 9: No. 11, 1553-1562(Nov 1974). (In French).

After several thermal treatments using an electron beam, remarkable configurations of interfacial dislocations between the layers in the monoclinic B type oxide, with different chemical composition (i.e., different ratio of Nd to Y) superimposed on one another were observed. Two modes of epitaxy between the hexagonal and cubic phases of the mixed oxides were observed: $(001)_{hex}$ parallel to $(111)_{cub}$ or to $(112)_{cub}$, although the binary diagram does not show any coexistence domain of those two phases. (auth)

9079 CATALYTIC EFFECT OF WATER ON THE SYNTHESIS OF CUBIC BN. Susa, K.; Kobayashi, T.; Taniguchi, S. (Hitachi Ltd., Tokyo). Mater. Res. Bull.; 9: No. 11, 1443-1446(Nov 1974).

The transition pressure and temperature of graphitic hexagonal boron nitride to the dense cubic form is drastically reduced by the presence of water in the starting material. A water content of about 40 wt % reduces these conditions to about 50 kbar and 600°C. Cubic BN obtained under such conditions is extremely small in crystal size, which was estimated by the broadening of x-ray powder diffraction lines. (auth)

9080 ORDER−DISORDER TRANSFORMATION FROM THE FLUORITE STRUCTURE TO THE PYROCHLORE STRUCTURE FOR THE $(1-x)ZrO_2-xLn_2O_3$ PHASES. Michel, D.; Jorba, P. Y.; Collongues, R. (CNRS, Vitry, France). Mater. Res. Bull.; 9: No. 11, 1457-1468(Nov 1974). (In French).

Pyrochlore type phases of formula $Ln_2Zr_2O_7$ (Ln = La, Nd, Sm, Gd) were studied by x-ray diffractometry, Raman spectroscopy, and electron microscopy. A disorder appears at high temperature for some of these phases and yields an oxygen-deficient fluorite type structure. Important modifications of the Raman spectra associated with this order−disorder transformation are related to the observation of anti-phase domains. (auth)

9081 CRYSTALLOCHEMICAL STUDY OF A NEW SERIES OF DOUBLE OXIDES OF RHENIUM AND THE RARE EARTHS. Baud, G.; Besse, J. P. (UER, Aubiere, France). Mater. Res. Bull.; 9: No. 11, 1499-1502(Nov 1974). (In French).

Preparation of a new series of heptavalent rhenium compounds of Ln_3ReO_8 type (Ln = rare earths) is described. The crystals are orthorombic for Ln = La (space groups Ccmm, $Ccm2_1$ or Cc2m) and Ln = Pr, ..., Gd (space group $B22_12$), face centered cubic of fluorite type for Ln = Tb, ..., Lu and Y. (auth)

9082 HIGH-PRESSURE SUBSTITUTIONS FOR Cd IN $Cd_2Nb_2O_7$ AND $Cd_2Ta_2O_7$. Sleight, A. W. (E. I. du Pont de Nemours and Co., Wilmington, DE). Mater. Res. Bull.; 9: No. 11, 1437-1442(Nov 1974).

Substitutions into cadmium niobate of the type $Cd_{2-x}A_xNb_2O_7$ ($x \leq 0.5$) were carried out at 58 kbars and 1100°C. The substituting A cations were Mg, Mn, Fe, Co, Ni, Cu, and Zn which are all smaller than Cd. Rhombohedral or triclinic distortions derived from cubic $Cd_2Nb_2O_7$ were achieved at values of x as low as 0.05. All the substituted phases appear to be centric at room temperature. Analogous substitutions into $Cd_2Ta_2O_7$ were also made. (auth)

9083 STRUCTURAL AND MAGNETIC PROPERTIES OF THE PEROVSKITE OXIDES Ba_2NbVO_6 AND Sr_2TaVO_6. Bernier, J. C. (ENSCS, Strasbourg); Chauvel, C.; Kahn, O. J. Solid State Chem.; 11: No. 4, 265-271(Dec 1974). (In French).

Ba_2NbVO_6 and Sr_2TaVO_6 were prepared by solid state reaction between 1100 and 1200°C in a high-temperature furnace. Crystallography of polycrystalline powders gives the spatial group Pm3m for the two perovskites. Magnetic susceptibilities were determined at 4.2−1200°K. Above 400°K, a theoretical interpretation is proposed by magnetic exchange interaction between pairs of vanadium. Parameters corresponding to this interpretation are calculated. (auth)

9084 STRUCTURAL ASPECTS OF THE METAL-INSULATOR TRANSITION IN V_5O_9. Marezio, M. (CNRS, Grenoble, France); Dernier, P. D.; McWhan, D. B.; Kachi, S. J. Solid State Chem.; 11: No. 4, 301-313(Dec 1974).

V_5O_9 undergoes a metal−insulator transition with decreasing temperature at ~135°K. The structures of both phases were refined at 298 and 110°K from single-crystal data. The triclinic structures ($P\bar{1}$) consist of layers of VO_6 octahedra extending indefinitely in the a−b plane and truncated by a shear plane after every 5 octahedra along the c axis. The average V−O distances for the V atoms at 298°K are for independent atoms 1−6: 1.949, 1.959, 1.965, 1.973, 1.967, and 1.971 Å, respectively. At 110°K the distances are 1.929, 1.975, 1.954, 1.994, 1.954, and 1.986 Å. These values are interpreted as evidence for charge localization in the insulating phase with alternate strings of V^{4+} ions and predominantly V^{3+} ions running along the pseudorutile c axis (3^+ chain is atoms 6−4−2−4−6 and 4^+-chain is 5−3−1−3−5). The oxygen atoms in the insulating phase relax toward V^{4+} string in the a_R and b_R directions and away from the V^{3+} string. The shear planes allow the V atoms to move along the c_R axis so as to compensate for the change in length of alternate chains. Short V−V distances comparable to those in VO_2 are not observed; however, the structure has multiple possible patterns of metal−metal bonds due to edge sharing of octahedra both along the pseudorutile c axis and between adjacent chains at the shear planes. (6 tables, 5 fig) (auth)

9085 HIGH-TEMPERATURE STUDY OF THE EQUILIBRIUM DIAGRAM OF THE SYSTEM FORMED BY LANTHANUM SESQUIOXIDE WITH YTTRIUM SESQUIOXIDE. Coutures, J.; Foex, M. (CNRS, Odeillo, France). J. Solid State Chem.; 11: No. 4, 294-300(Dec 1974). (In French).

The study up to the melting point of the system shows the formation of several very extended solid solutions, each corresponding to a form given in these conditions by rare earth sesquioxides. The phases determined in situ at high temperature are very different from those observed with products cooled down to room temperature. The influence of quenching and annealing is demonstrated, particularly with $LaYO_3$. (7 fig) (auth)

9086 TEMPERATURE DEPENDENCE OF ELASTICITY CONSTANTS OF NON-STOICHIOMETRIC ZIRCONIUM CARBIDES. Baranov, V. M.; Knyasev, V. I.; Korostin, O. S. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). Probl. Prochnosti; No. 9, 45-47(Sep 1973). (In Russian).

For English translation see the journal Strength Mater.

The temperature dependence of the elasticity modulus M and the Poisson coefficient G of zirconium carbides ZrC_x with 0.77

$\leq x \leq 0.96$ was studied in the temperature interval from 20 to 2100°C. The linear increase of E and the Debye temperature with increase of x was established. At temperatures roughly equal to 0.5 T_f, the character of the change of E is close to linear. For much higher temperatures the change of the elasticity modulus is described by the formula $E = E_a - BT_{exp}(-T_0/T) - C_{exp}(-H/RT)$. The very intense decrease of the value of E at $T \gtrsim 0.5\ T_f$ was noted for carbides with a decrease of the value of x. The Poisson coefficient increases negligibly with increase of the temperature. (tr-auth)

9087 STUDY ON THE CARBIDE CATHODES SURFACES BY THE ELECTRON AUGER-SPECTROSCOPY METHOD. Kul'varskaya, B. S.; Cherevatskij, N. Ya. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 2, 374-375(Feb 1974). (In Russian).

For English translation see the journal Bull. Acad. Sci. USSR, Phys. Sci.

The change of the chemical composition of the surface of ZrC cathodes was studied by the method of Auger electron spectroscopy. The use of Auger spectroscopy makes it possible to establish that the formation of effective electron emitters with increased thermoemission from ZrC with Os films at temperatures of 2000°C is connected with the diffusion from the interior of the ZrC and partially with the adsorption of C on the surface of Os films deposited on the ZrC. (tr-auth)

9088 RARE EARTH - COBALT BORIDES. Rogl, P. (Vienna Univ. (Austria). Inst. fuer Physikalische Chemie). Monatsh. Chem.; 104: No. 6, 1623-1631(Nov 1973). (In German).

$YbCo_3B_2$, $PrCo_2B_2$, and $HoCo_2B_2$ were prepared from the elemental components. $YbCo_3B_2$ belongs to the ordered $CaCu_5$-type structure, $PrCo_2B_2$ and $HoCo_2B_2$ crystallize with the ordered $BaAl_4$-($ThCr_2Si_2$)-type structure. The crystal chemistry of the isotopic series of $RECo_3B_2$ as well as of $RECo_2B_2$ compounds are discussed. (auth)

9089 STUDY OF VOID VOLUMES IN NIOBIUM MONOXIDE WITH THE AID OF THE TRACER-ATOM METHOD. Samoilov, A. S.; Mosevich, A. N.; Smirnova, V. I.; Ormont, B. F. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 4, 809-812(Apr 1974).

Translated from Zh. Prikl. Khim.; 47: No. 4, 793-797(Apr 1974).

Absorption of ^{85}Kr-labeled gas by $Nbo_{1.00}$ was studied. Pycnometric and x-ray densities were also determined. Results show that $NbO_{1.00}$ has primarily a skeletal structure due to extended volume defects of type II (closed microcavities and microcracks). Higher temperature and longer heat treatment lead to a higher percentage of these defects. (DLC)

9090 SOME CHARACTERISTICS OF RECOMBINATION OF HYDROGEN ATOMS ON THE SURFACE OF ZIRCONIUM AND TITANIUM HYDRIDES AND CARBOHYDRIDES. Lavrenko, V. A.; Morozov, V. V.; Protsenko, T. G.; Kalenichenko, A. M.; Tikush, V. L.; Antonova, M. M. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 4, 780-783(Apr 1974).

Translated from Zh. Prikl. Khim.; 47: No. 4, 763-767(Apr 1974).

Proton magnetic resonance was used to study $Zr\ H_x$ ($x = 1.6$ to 2) and $Ti\ H_x$ ($x = 1.43$ to 2). The recombination coefficient (RC) for $Zr\ H_x$ falls with x, reaching a minimum at $x = 1.8$, and then increases again. For $Ti\ H_x$, on the other hand, RC remains constant. Carbohydrides of the composition $TiC_{0.44}H_{0.79}$ to $TiC_{0.97}H_{0.01}$ and $ZrC_{0.64}H_{0.31}$ to $ZrC_{0.87}H_{0.11}$ were also studied; their RCs were found to be smaller than these of the corresponding carbides. Second magnetic moments were also determined from the spectra. The electronic structure effect on adsorption is discussed. (DLC)

9091 METHOD OF MAKING URANIUM SESQUICARBIDE. Tagawa, H.; Fujii, K. (to Eiji Munekata). US Patent 3,836,631. 17 Sep 1974. Priority Date 19 Jul 1971, Japan. 4p.

This invention relates to a method of making uranium sesquicarbide U_2C_3 by mixing uranium dicarbide UC_2 with metal oxide and subjecting the mixture to heating in vacuum. (Official Gazette)

9092 THE EFFECT OF TITANIA ON GRAIN GROWTH AND DENSIFICATION OF SINTERED UO_2. Ainscough, J. B.; Rigby, F.; Osborn, S. C. (UKAEA Reactor Group, Springfields). J. Nucl. Mater.; 52: No. 2, 191-203(Oct 1974).

The effect of additions of up to 0.33 wt % titania on the grain growth and densification of UO_2 was studied. It is shown that the solubility of titania in UO_2 lies between 0.07 and 0.13 wt % at 1650°C in hydrogen and that the grain growth rate is proportional to the concentration of added titania up to the solubility limit, remaining constant thereafter. Titania in excess of the solubility limit forms a liquid eutectic with UO_2. This eutectic, which has a solidification temperature in the 1600–1620°C range, inhibits grain growth at temperatures below 1600°C but can enhance it at higher temperatures where the eutectic is liquid. TiO_2 is not as effective as the lower oxides in promoting grain growth. (auth)

9093 QUASI-MOLECULAR LARGE UNIT CELL MODEL IN THE THEORY OF DEEP LEVELS IN IMPERFECT CRYSTALS: POINT DEFECTS IN GRAPHITE BORON NITRIDE. Dobrotvorskii, A. M.; Evarestov, R. A. (Leningrad State Univ.). Phys. Status Solidi (b); 66: No. 1, 83-91(1 Nov 1974).

The possibilities of the quasimolecular large unit cell approach in the theory of deep energy levels in imperfect solids are discussed and some general principles of its realization are formulated. The success of this approach is illustrated by the application to the defect level problem in graphite boron nitride (vacancies and impurity carbon atoms at boron and nitrogen lattice sites are considered). The results obtained are compared with available experimental data, and possible defect models are discussed. (auth)

9094 THE EFFECT OF FISSION FRAGMENT IRRADIATION UPON THE ACTIVE TO PASSIVE TRANSITION IN THE OXIDATION OF SELF-BONDED REFEL SILICON CARBIDE AT 850–950°C. Bennett, M. J.; Chaffey, G. H. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). J. Nucl. Mater.; 52: No. 2, 184-190(Oct 1974).

With increasing oxidant pressures there can be two successive modes of oxidation (active and passive) of silicon carbide and silicon, resulting in the formation of either volatile silicon monoxide, or a protective silica layer. The active corrosion of REFEL silicon carbide, containing ~16% free silicon, was examined experimentally out-of-reactor at lower temperatures than previously and was shown to occur at 900 and 950°, but not at ≤875°C. The oxygen pressures for the transition to the passive type of oxidation were not greater than those calculated on the basis of a theoretical model. Irradiation with a fission fragment flux of 1×10^{11} ff/cm²sec did not affect significantly either the minimum temperature for the onset of active corrosion or the active-passive oxidation transition pressure, at temperatures up to ~950°C. (auth)

9095 PHYSICAL PROPERTIES OF SOME THORIA POWDERS AND THEIR INFLUENCE ON SINTERABILITY. Pope, J. M.; Radford, K. C. (Westinghouse Research Labs., Pittsburgh, Pa. (USA)). J. Nucl. Mater.; 52: No. 2, 241-254(Oct 1974).

The physical characteristics of thoria powders are dependent upon the precursor material and the calcining temperature. ThO_2 powders were prepared by calcining thorium oxalate precipitated from thorium nitrate, and by calcining $Th(NO_3)_4 \cdot 4H_2O$ directly. In addition, a mixed oxide was produced by calcining a coprecipitate of ammonium diuranate and thorium hydroxide. A range of calcining temperature was investigated and the physical properties of the resulting oxides determined. Parameters measured included surface area, bulk and tap densities, Fisher subsieve particle size, as well as an examination of the powder morphology and particle size distribution using electron microscopy and x-ray sedimentation analysis. These properties were correlated to the sinterability of the powders. (auth)

9096 THE DEPENDENCE OF IN-REACTOR UO_2 DENSIFICATION ON TEMPERATURE AND MICROSTRUCTURE. Stehle, H.; Assmann, H. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). J. Nucl. Mater.; 52: No. 2, 303-308(Oct 1974).

The in-reactor changes in size of sintered UO_2 are analyzed by superposing matrix swelling and pore shrinkage. At first pore shrinkage dominates the results in densification, an effect which has been known for a few years. With regard to shrinkage mechanisms one should distinguish between very fine pores and coarser pores, the latter being responsible for the majority of total porosity in well sintered UO_2. For this coarser porosity a two-step mechanism is postulated: first, the generation of vacancies by the fission fragments traversing the pores, second, the migration of these vacancies to effective sinks (grain boundaries) producing densification. Based on this assumption the dependence of densification on fission rate, temperature, pore size distribution and grain size is evaluated. There is a transient temperature above which the generation of vacancies is rate controlling and below which the vacancy migration becomes the rate controlling mechanism. At temperatures much lower than the transient temperature no densification should be observed. (auth)

9097 OBSERVATIONS ON THE RADIAL AND AXIAL SHRINKAGE BEHAVIOUR OF CaF_2 AND UO_2 POWDER COMPACTS. Nazmy, M. Y.; Abdel-Azim, M. S. (Atomic Energy Establishment, Cairo (Egypt)). J. Nucl. Mater.; 52: No. 2, 296-302(Oct 1974).

The effect of compacting pressure, shape and size of powder particles, and sintering temperature on the radial, axial, and radial-to-axial shrinkage ratio for CaF_2 and UO_2 were studied. For CaF_2 the radial-to-axial shrinkage ratio was close to unity regardless of particle size, compacting pressure and sintering temperature. The same effect was observed in UO_2 powder compacts. The radial and axial density distributions in CaF_2 compacts were determined. Unlike in soft metals, it was found that both distributions were almost identical and they also behaved the same with increasing compacting pressure. The radial-to-axial shrinkage ratio of a slip-cast CaF_2 specimen was also found to be close to unity. The value of the radial-to-axial shrinkage ratio in CaF_2 and UO_2, which approached unity in both cases, was attributed to the similarity in radial and axial density distributions. (auth)

9098 SYNTHESIS AND INFRARED SPECTRA OF THE TITANONIOBATES OF GADOLINIUM, TERBIUM, AND DYSPROSIUM. Sych, A. M.; Klenus, V. G. (Kiev State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 4, 541-545(Apr 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 4, 634-639(Apr 1974).

Titanoniobates of Gd, Tb, and Dy can be obtained by roasting coprecipitated hydroxides at 900°C. Chemical interaction occurs at the moment of coprecipitation of the hydroxides. X-ray diffraction showed that the compounds crystallize with the euxenite structure. Infrared spectra of the compounds were obtained in the region 30-1200 cm^{-1}. Factor-group analysis was used in explaining the observed multiplicity of the vibration frequencies by resonance interaction between internal vibrations of the oxygen octahedra. (auth)

9099 OPTICAL PROPERTIES AND CHEMICAL BONDING IN VANADIUM PENTOXIDE. Kutolin, S. A.; Botvinkova, G. S.; Kotenko, O. M.; Samoilova, R. N.; Dokuchaeva, I. M. Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 4, 550-554(Apr 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 4, 645-649(Apr 1974).

A study using the Kramers–Kronig analysis method was made of the optical properties of polycrystalline V_2O_5; dispersions of ϵ_1, ϵ_2, and n were calculated at wavelengths of 0.05 to 25 μ. There is satisfactory agreement between the calculated optical properties of polycrystalline and monocrystalline V_2O_5. Electrophysical and physicochemical properties of polycrystalline V_2O_5 and the degree of ionicity were determined. On the basis of calculations of the phonon spectrum and optical transition energy of V_2O_5 in the range $E \geq E_g$. V_2O_5 has a quasimolecular structure, which characteristically forms structures with variable valence of the type $V^{4+}-V^{5+}-O^{2-}$. (4 figures, 2 tables) (auth)

9100 ELECTROPHYSICAL PROPERTIES OF VN_{1-x} AND THE TERNARY COMPOUND WITH THE NaCl STRUCTURE IN THE SYSTEM V–B–N. Aivazov, M. I.; Domashnev, I. A.; Muranevich, A. Kh. (Inst. of New Chemical Problems, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 4, 515-517(Apr 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 4, 604-606(Apr 1974).

Electrical conductivity, thermo-emf, and R_H were investigated in the temperature range 77 to 1400°K in the region of homogeneity of VN_{1-x} and in the compound $VB_{0.55}N_{0.77}$. Existence of narrow partly filled t_{2g}– and e_g– zones, with an energy gap ~kT between them. (auth)

9101 X-RAY DIFFRACTION PROFILES FROM NEUTRON-IRRADIATED MAGNESIUM OXIDE. Howard, C. J.; Sabine, T. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Phys., C (London); 7: No. 19, 3453-3466(7 Oct 1974).

The profile of the (200) x-ray reflection from neutron-irradiated MgO was examined. The changes in this profile with increasing neutron dose, and the changes after subsequent annealing, are attributed to effects of point defects and interstitial dislocation loops. The dislocation loops are larger after higher doses, and they grow too during annealing from the coalescence of interstitial point defects. Interpretation of the x-ray scattering from distorted crystals is discussed. (auth)

9102 FRACTURE PARAMETERS IN REFEL SILICON CARBIDE. Henshall, J. L.; Rowcliffe, D. J. (Brown, Boveri and Co. Ltd., Baden, Switzerland). J. Mater. Sci.; 9: No. 9, 1559-1561(Sep 1974).

The critical stress intensity factor in plane strain (K_{1c}) for ceramics is generally determined from three- or four-point bend tests. Summers et al. (Proceedings of the 12th Symposium on Rock Mechanics, Society of Mining Engineers (A.I.M.M.P.E., New York, 1971, p. 241) have determined the correct equation to use for three-point bend tests but no similar evaluation has been made for four-point bending. Values of K_{1c} for Refel silicon carbide calculated by applying various analytical expressions to data obtained from four-point bend tests are compared. In addition the effects of precracking on K_{1c} were investigated. (auth)

9103 MELTING TEMPERATURE AND HIGH-TEMPERATURE ENTHALPIES OF ERBIUM TETRABORIDE. Mar, R. W. (Sandia Labs., Livermore, CA); Stout, N. D. J. Chem. Thermodyn.; 6: No. 10, 943-947(Oct 1974).

The high-temperature enthalpy of ErB_4 was measured from 1312 to 2227 K with a copper-block drop calorimeter. The results were fitted to the following equation, which should be used only over the experimental range: $H^\circ(T)-H^\circ(298.15\ K) = \{17.372(T/K) + 4.740 \times 10^{-3}(T/K)^2 + 0.871 \times 10^6(T/K)^{-1} - 2.679 \times 10^3\}\ cal_{th}\ mol^{-1}$. The melting temperature was determined by a heating-curve technique and found to be (2633 ± 50) K. (auth)

9104 COMPOSITION LIMITS AND VAPORIZATION BEHAVIOUR OF RARE EARTH NITRIDES. Brown, R. C.; Clark, N. J. (Flinders Univ. of South Australia, Bedford Park). J. Inorg. Nucl. Chem.; 36: No. 11, 2507-2514(Nov 1974).

Phase relationships in the praseodymium, holmium and erbium nitrogen systems were investigated by chemical, x-ray, and metallographic techniques. Particular attention was paid to the problem of oxygen contamination and an analytical method was devised for the determination of oxygen in rare earth oxynitrides. A substoichiometric existence range of less than 0.05 atomic units in $MX_{1.00}$ (where X is the total non-metal content) was found for praseodymium nitride, whereas the holmium and erbium systems showed a broader range (ca.0.10 a.u.) at higher temperatures. The effects of substoichiometry on the nitride lattice parameters are small and can easily be hidden by changes due to sample contamination. The vaporization of lanthanum, cerium, praseodymium, gadolinium and terbium nitrides was found to be incongruent at 1600°C, whereas samarium, holmium, erbium and ytterbium nitrides vaporized congruently. (auth)

9105 MAGNETIC SUSCEPTIBILITY OF DIBORIDES OF TRANSITION METALS OF GROUPS IV–VI. L'vov, S. N.; Lesnaya, M. I.; Vinitskii, I. M.; Kovenskaya, B. A.; Makosevskii, B. G. (Kherson Pedagogic Inst., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 4, 512-514(Apr 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 4, 600-603(Apr 1974).

At 100 to 300°K, the magnetic susceptibility of diborides of transition metals of Groups IV–VI and of the similar phases Mo_2B_5 and W_2B_5 depends weakly on temperature, indicating that localized magnetic moments make no contribution. In general, the fact that the paramagnetism of these compounds is weaker than that of the initial metals (some compounds are even diamagnetics) is very probably due to the location of their Fermi level in the region of the deep minimum of the density curve of the d-states. (auth)

9106 ELECTRICAL PROPERTIES OF CERAMIC MATERIALS BASED ON ALUMINA-DOPED NIOBIUM PENTOXIDE. Fedorov, N. F.; Andreev, I. F.; Kasparyan, R. M.; Cherkudinov, A. S. (Leningrad Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 4, 648-649(Apr 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 4, 753-754(Apr 1974).

There is interest in the development of ceramics with reduced dielectric constants at high and superhigh frequencies. ϵ and tan δ were measured for Nb_2O_5/Al_2O_3 ratios of 49 to 1, at 10^3 to 10^{10} Hz and 77 to 500°K. The sharpest decrease in dielectric properties was obtained for 95.45 mole % Nb_2O_5. (DLC)

Metals and Alloys

9107 (RDT-M-2-4T(11-74)) ALLOY STEEL FORGINGS (ASME-SA-336 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Nov 1974 10p. RSO.

This standard covers alloy steel forgings for nuclear and associated applications. (DLC)

9108 (RDT-M-3-3T(11-74)) AUSTENITIC STAINLESS STEEL SEAMLESS PIPE (ASME SA-376 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Nov 1974. 8p. RSO.

This standard covers austenitic stainless steel pipe for nuclear and associated applications. (DLC)

9109 (RDT-M-4-2T(11-74)) AUSTENITIC STAINLESS STEEL CASTINGS (ASME SA-351 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Nov 1974. 7p. RSO.

This standard covers austenitic stainless steel castings for nuclear and associated applications. (DLC)

9110 (RFP-2106) URANIUM–NIOBIUM ALLOYS: ANNOTATED BIBLIOGRAPHY. Part I. Journal Articles, Formal Reports, and Patents. Part II. Progress Reports and Newsletters. Jackson, R. J. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 28 Oct 1974. Contract AT(29-1)-1106. 75p. Dep. NTIS $4.00.

An annotated bibliography current as of June 1, 1973, on binary U–Nb alloys was prepared from NSA entries and additional sources. Part I contains 225 references. Part II has 134 references. Included are a subject index, source (organizations) data, and an author index. (DLC)

9111 INTERNAL NITRIDING OF METALS AND ALLOYS. Lakhtin, Yu. M.; Kogan, Ya. D. (Moscow Highway Inst.). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 3–4, 217-224 (1974).

Translated from Metalloved. Term. Obrab. Metal.; 16: No. 3, 20-28(Mar 1974).

An analysis is made of diffusion saturation of metals and alloys with N. Depending on the N affinity of the alloying element, first- or second-order internal nitridation (surface nitride zone and diffusion sublayer) may occur. Use of internal nitridation to improve the properties is discussed. Technology for carrying out the internal nitridation is also discussed. (DLC)

Corrosion and Erosion

9112 (AECL-4664) HYDRIDING OF Zr_3Al-BASED ALLOYS. Cameron, D. J.; Faulkner, D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Aug 1974. 33p. Dep. NTIS (US Sales Only) $4.75. AECL $1.00.

8.3% Al alloy was hydrided to 1300 μg H per gram of alloy and 9.6% Al alloy was hydrided to 1040 μg per gram at 923°K. Effect of subsequent heat treatment at 973, 773, and 623°K on the phase relationships in the hydrided alloys was studied by optical and transmission electron microscopy, and x-ray diffraction. No hydrides were found in any of the alloys, although some minute unidentified precipitation was observed in the Zr_2Al phase of some 9.6% Al alloys. Addition of H even in relatively small amounts causes the decomposition of the Zr_3Al phase to α-Zr and Zr_2Al in the 8.3% Al alloy. This effect is observed only at much higher hydrogen contents in the 9.6% Al alloy, in which it is believed that the pre-existing Zr_2Al phase acts as a hydrogen sink. A schematic partial ternary phase diagram of the Zr–Al–H system is suggested to explain these observations. (18 figures) (auth)

9113 (CONF-740988-1) RESULTS ON INCOLOY 800 AND ALLIED STEAM GENERATOR MATERIALS IN FLORIDA FIELD CORROSION TESTS. Hammond J. P.; Patriarca, P.; Slaughter, G. M.; Maxwell, W. A. (Oak Ridge National Lab., Tenn. (USA)). 1974. 24p. Dep. NTIS $4.25.

Corrosion of similar- and dissimilar-metal weldments in Incoloy 800 and various Ni base alloys for use in advanced gas-cooled nuclear steam generators was studied in isothermal exposures in dynamic steam at 595 and 650°C for periods of 16,000 h (2 y). Cursory examinations were made on some weldment specimens after 27,000 h. Twelve alloy combinations, in which high-temperature base metals (i.e., Inconel 625, Hastelloy X, and IN 102) were joined to Incoloy 800 and to themselves, were examined in the surface-ground condition. Three high-temperature alloys and Inconel 82 were employed as filler metals. To assess surface condition effects, the dissimilar-metal weldments and nonwelded specimens in the various base metals were also tested after electropolishing. General corrosion was determined by weight-gain, weight-loss, and scale thickness measurements, and preferential attack in fusion-line areas was assessed by metallography. Projected long-time corrosion amounts were very small (<11 mg/cm^2 in 20 y) for all the weldments tested except those in Inconel 600, and for this weldment the projected corrosion was only 43 mg/cm^2 after 20 y. No evidence of aggravated attack at fusion line areas was disclosed. Results appear to be applicable to steam at lower temperatures. (auth)

9114 EMISSION–ADSORPTION CHARACTERISTICS OF PRASEODYMIUM FILMS ON THE (110) AND (100) FACES OF SINGLE CRYSTAL TANTALUM. Bekbauliev, B.; Smirnov, B. G.; Smirnova, N. B. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 66-67(1974). (In Russian).

Results of studying film systems in a spherical thermoelectron projector are presented. A beaker made of zone-purified molybdenum filled with Pr metal served as the source of the adsorbate. The constancy in flux of Pr atom was fixed by the source temperature. Thermoemission was measured in a vacuum of 1×10^{-9} mm Hg std. The work function was determined from the total current, and the heat of adsorption from a straight-line Arrhenius plot during sputtering of the adsorbate. Adsorption isotherms are presented for the system Pr(100)–Ta at a constant flux of continuously sputtered adsorbate. Similar adsorption isotherms and close values of the work function were also obtained for the system Pr(110)–Ta. Up to 1400°K, high values of the work function are obtained. The sharp change in the form and position of the absorption curves with temperature may be associated with the dissolution of Pr in Ta (solubility of ~0.05% Pr in Ta). Values of the heat of absorption are 5.08 eV for the (110) face and 4.40 eV for the (100) face. A picture of the thermoemission distribution on the surface of a tantalum crystal is presented. It is evident that Pr atoms are retained longer on the (110) face. (SJR)

9115 FIELD CRYSTALLIZATION OF ANODIC FILMS ON TANTALUM. Jackson, N. F. J. Appl. Electrochem.; 3: No. 2, 91-98(May 1973).

The radial growth rate of crystalline areas during the anodization of Ta is related to the nature and concentration of both the solute and the solvent and also to the pH of the electrolyte. In general, the use of high solute concentrations or the addition of certain organic solvents produces reduced growth rates in aqueous electrolytes. Structural examinations indicate that for bright rolled Ta foil of nominal purity 99.99%, the density of nucleation sites is $\sim 10^7$/cm^2, of which ~1% undergo active radial growth. The nucleation sites, which can be related to impurity inclusions, are believed to maintain contact with the electrolyte through narrow pores. As the amorphous oxide is rolled back by the growing crystals, a layer of relatively uniform thickness is stripped from the top surface of the crystalline area and remains in intimate contact with the detached amorphous oxide. The use of field crystallization to study the location and distribution of impurities at both exterior and interior surfaces of sintered powder anodes is described. (Metals Abstr.)

9116 INTERACTION WITH CARBON OF BORIDE COATINGS ON MOLYBDENUM AND TUNGSTEN. Evtushok, T. M.; Zhunkovskii, G. L. Zashch. Pokrytiya Metal.; No. 7, 192-195(1973). (In Russian).

The possible use of boride coatings on Mo and W as barriers against their carburization in C-containing atmospheres at high temperature was studied. The borided specimens were heated in Ar, in contact with graphite in vacuum, and in carbon black in H or vacuum. Data were first obtained for the behaviour with temperature of the borided layer in the absence of C. The temperature limits of stability were determined. These limits set the temperature for the interaction of C with the layers, e.g. carbides form by reaction of C with the lower borides, which in turn are produced from the higher borides at these temperature limits. (Metals Abstr.)

9117 MASS SPECTROMETRIC SYSTEM FOR ANALYZING THERMAL DESORPTION SPECTRA OF ION-IMPLANTED ARGON AND CESIUM IN TUNGSTEN. Wood, G. M. Jr. Troy, NY; Rensselaer Polytechnic Inst. (1974). 235p. University Microfilms Order No. 74-26,100.

Thesis (Ph.D.).

A mass spectrometric system was developed for determining the characteristics of materials used in instrument and aerospace. Initial investigations were centered on desorption spectra of cesium ion-implanted into polycrystalline W, and on the effects of bombardment of the W surface by 70-eV electrons. The system also includes provisions for measuring work function changes by the retarding potential diode method, for flash desorption characteristics, and for the gas-reaction mechanisms of the surface of heated metal filaments. A Bendix time-of-flight mass spectrometer was selected to be the basis of the system due to its fast scan rate and the open geometry of the ion source. An ion source was designed so that the ions could be generated either by surface ionization or by electron bombardment. Two such sources were constructed; one included a special heated capillary inlet for the introduction of gases directly onto the surface of the filament. The ion detector was the conventional Bendix magnetic electron multiplier; however, the analog and oscilloscope display systems were augmented by a 100-MHz pulse counting system and delay circuitry. The vacuum system was augmented with a 425 l/s ion pump and cold traps to prevent hydrocarbon backstreaming from the pump. Results of the study indicated an anomalous desorption mechanism following electron bombardment. These spectra cannot be explained on the basis of a simple diffusion-controlled desorption from the bulk but are indicative of the formation of activation sites on or near the surface. The enhanced spectra are a function of the post-bombardment time and energy, and are suggestive of an increased concentration of cesium atoms, up to 10 or more angstroms below the surface. This concentration may be the result of surface-like diffusion through damage zones, activated by energy transfer via a Franck–Condon excitation process along the range of penetration of the electrons. (DLC)

9118 CORROSIVE EFFECT OF NEUTRON AND GAMMA IRRADIATION ON X18H10T STEEL IN N_2O_4 AT HIGH TEMPERATURE. Sukhotin, A. M.; Fedyushin, E. E.; Matushkin, V. A.; Gerasimova, V. A. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 19-23(1973). (In Russian).

A description was given of the methods and experimental installation used for the study of the radiation corrosion of metallic materials in gaseous N_2O_4 at high temperatures and pressures. By means of the resistometric method a study was made of the kinetics of the corrosion of the stainless steel Kh18N10T in N_2O_4 in static conditions at a temperature of 550°C and pressure of 50 atm under conditions of reactor irradiation during cyclical test regimes. It was shown that the corrosion rate of the steel in these conditions decreased with time and was 0.009 mm/yr for a time period of 280 hrs. (tr-auth)

9119 DETERMINATION OF CORROSION CURRENTS AT TYPE ST. 3 STEEL WITH AN ELECTROLYTICALLY DEPOSITED NICKEL–MOLYBDENUM PLATING. Stasov, A. A.; Pasechnik, S. Ya. (Voronezh Technological Inst., USSR). Prot. Metals (USSR) (Engl. Transl.); 10: No. 2, 196-197(1974).

Translated from Zash. Metal.; 10: No. 2, 206-208(1974).

Ni–Mo platings containing 5, 10, 20, and 30% Mo were applied to type St. 3 steel from a pyrophosphate electrolyte. Corrosion tests were conducted in 3% NaCl solution in air without agitation. Platings were removed from the base for cathodic polarization curve and steady-state potential measurements. Corrosion currents were also determined from weight losses. Results of the two methods agreed with each other; the Ni–Mo alloys had a corrosion resistance higher than that of Ni alone. (DLC)

9120 ADHESION AND PROTECTIVE PROPERTIES OF ZINC AND CADMIUM VACUUM COATINGS. Roikh, I. L.; Budyuk, L. F.; Modzelevskii, A. A.; Rafalovich, D. M.; Snitkovskaya, L. M. (Odessa Technological Inst.). Prot. Metals (USSR) (Engl. Transl.); 10: No. 2, 198-200(1974).

Translated from Zash. Metal.; 10: No. 2, 208-211(1974).

Good adhesion of coatings to high-strength steels was obtained by preliminary heating of the steel in a vacuum at 500° for 15 s, preliminary surface treatment of the steel in a glow discharge, or by applying a 1-μ intermediate Sn layer to the steel after heating to 180°. Effects of the Sn layer on the protective properties of Zn and Cd were investigated by conducting accelerated and full-scale (1 year) in seawater and various climates. For protecting steel parts in seawater, a Sn/Cd vacuum coating of thickness 15μ or more is recommended, while in a tropical climate a Sn/Zr coating is more economical. (DLC)

9121 CORROSION CHARACTERISTICS OF RHENIUM, MOLYBDENUM, TUNGSTEN, NIOBIUM, AND THEIR ALLOYS IN SEAWATER. Korovin, Yu. M.; Ulanovskii, I. B. (Inst. of Physical Chemistry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 10: No. 2, 157-159(1974).

Translated from Zash. Metal.; 10: No. 2, 167-170(1974).

The corrosion and electrochemical characteristics were studied for Mo, W, Re, Nb, and the alloys MR-47 (Mo–47% Re), VR-27 (W–27% Re), TsM2A (Mo–0.2% Ti–0.1% Zr), and 5VMTs (Nb–2% Mo–0.75% Zr–5% W). Effects of time, O_2, and pH were also studied. (5 tables) (DLC)

9122 EFFECT OF HEATING METHOD ON HIGH-TEMPERATURE OXIDATION OF ZIRCONIUM IN GASEOUS PHASE. Opara, B. K.; Fokin, M. N.; Vtulkin, A. V.; Kravetskii, K. A.; Bartini, O. G. (Moscow Inst. of Steel and Alloys). Prot. Metals (USSR) (Engl. Transl.); 10: No. 2, 166-168(1974).

Translated from Zash. Metal.; 10: No. 2, 175-178(1974).

Kinetics of oxidation of iodide zirconium in air at 900 to 1400°C was studied with heating in a resistance furnace with Silit heating elements and with induction heating in MGZ-52 apparatus (2.5 kHz frequency). The effects of heating method on the time of change to linear oxidation and on the formation of the oxide film were studied. (DLC)

9123 INTERNAL OXIDATION OF QUATERNARY ALLOYS OF SILVER. Pravoverov, N. L. (All-Union Scientific-Research Inst. of Electromechanics, Moscow). Prot. Metals (USSR) (Engl. Transl.); 10: No. 2, 169-171(1974).

Translated from Zash. Metal.; 10: No. 2, 179-182(1974).

Effects of small admixtures (0.015 to 0.7%) of Mg, Mr, Zr, Y, La, or Ce and of the oxidation temperature on the internal oxidation kinetics of Ag–0.4 to 0.5% Pd–0.13 to 0.27% Ni were studied. The additions were found to decrease the oxidation rate and activation energy. After oxidation, the hardness and strength increase sharply, and the plasticity remains very high. Predeformed alloys are oxidized more intensely than those annealed in vacuum. (DLC)

9124 INFLUENCE OF THE RATE OF OXIDATION OF 15Cr2MoVA ALLOY IN HEAVY-WATER VAPOR ON DIFFUSION OF THE DEUTERIUM EVOLVED. Belyakov, Yu. I.; Zvezdin, Yu. I.; Kurdyumov, A. A. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 4, 806-808(Apr 1974).

Translated from Zh. Prikl. Khim.; 47: No. 4, 790-793(Apr 1974).

The steel has the composition 0.15% C, 2.5% Cr, 0.6% Mo, 0.25% V, 0.3% Mn, 0.17% Si, balance Fe. Dependence of deuterium flux density P on duration and thickness was determined. The initial decrease of P was found to be due primarily to decrease of the preexponential factor; after 7 to 8 h, P is stabilized. Results are related to the corrosion resistance. An experiment confirmed Partridge's hypothesis that the H evolved under the oxide film makes the main contribution to H absorption by metals. (DLC)

9125 EFFECT OF FISSION PRODUCT ATTACK ON THE MECHANICAL PROPERTIES OF FUEL CLADDING ALLOYS. Rosa-Gonzalez, F. Tucson, AZ; Univ. of Arizona (1974). 67p. University Microfilms Order No. 74-21,127.

Thesis (Ph. D.).

Effect of grain-boundary attack by cesium oxides on the mechanical properties of 20% cold-worked Type 316 austenitic stainless steel was determined by tensile and biaxial stress-to-failure tests from 540 to 760°C on specimens exposed to cesium oxides out-of-pile. Reduction in strength and ductility were observed at all temperatures for an increase in grain-boundary penetration depth. Penetration depths from 0 to 250 microns resulted from exposure to cesium oxides for varying lengths of time at 660°C. The tensile strength of the exposed material was directly proportional to the remaining unpenetrated area, so a thinning criterion was developed to predict the load-bearing capacity of the specimen after a given grain-boundary penetration depth is achieved. The temperature-dependent ductility of the material decreased rapidly with penetration depth, and was at a minimum at 593°C. Uniform elongation was not strongly affected, above 650°C, until about 40% of the cross-sectional area of the specimen was penetrated. In biaxial stress-to-failure tests, the strength reduction from grain-boundary corrosion can be explained by assuming that the effect of grain-boundary penetration is equivalent to the reduction in the tube-wall thickness of the specimen. The "tube-wall thinning criterion" is a reasonable approximation, since the failure time for the exposed specimens can be predicted from the unexposed specimen data within a factor of three. Ductility, from average diametral strain, was most affected by grain boundary attack at 704°C. At all temperatures, a decrease in the average diametral strain rate caused a change in failure mode from rupture to pinhole failure. (DLC)

9126 THE HOT STEAM CYCLE FOR CORROSION EXPERIMENTS UNDER HEAT FLUX: DESIGN, OPERATION AND PRELIMINARY RESULTS. Erbacher, F. J.; Jennert, D.; Leistikow, S.; Vasarhelyi, J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorbauelemente). J. Nucl. Mater.; 52: No. 2, 204-214(Oct 1974). (In German).

In order to investigate the corrosion in hot steam of superheated materials at high heat fluxes, a high-pressure steam loop was constructed and was run successfully for two years. Thin-walled incoloy 800 tubing in intimate contact with insulated resistance heaters at temperatures of 500–700°C and heat flows of 200 W/cm^2, and also sheets of various alloys held isothermally at 600°C, were exposed to steam for long periods. The results show that, within the limitations of the experiment, a high heat flux through the tubing into rapidly streaming pressurized steam does not enhance the corrosion rate, and only highly pessimistic assumptions would justify an extrapolation to indicate enhanced corrosion at long exposure times (analogous to the similar extrapolation which was made for medium heat fluxes). (INSPEC)

9127 SODIUM/WATER COMBUSTION AND THE CHEMISTRY OF WASTAGE AT SODIUM/WATER LEAK SITES. Newman, R. N.; Smith, C. A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). J. Nucl. Mater.; 52: No. 2, 173-183(Oct 1974).

The ignition and combustion of sodium in water vapor are demonstrated experimentally, and the composition and temperature of the flame region are discussed in terms of thermodynamic and kinetic factors. Steels were shown to suffer rapid wastage in these flame regions. Corrosion tests to simulate the chemical environment of the flame showed that a greater rate of attack on 2.25 Cr–1 Mo steel occurred with sodium hydroxide in a water vapor atmosphere than with sodium hydroxide alone. Extrapolation of these corrosion rates to the steel temperature in the flame leads to the conclusion that these corrosion processes are the origin of the flame wastage. The tube wastage found during water injection tests in fast reactor heat exchangers is discussed in terms of rapid corrosion by sodium hydroxide and water vapor within the flame region generated at the boundary of the water jet. (auth)

Preparation and Fabrication

9128 (AD-783180) TITANIUM–BERYLLIUM MICROCOMPOSITES, STATE-OF-THE-ART REVIEW. Final Report. Isserow, S. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Apr 1974. 13p. (AMMRC-MS-74-5). NTIS $3.00.

Ti–Be composites were developed over a broad range of compositions to take advantage of the low density and high modulus of Be while Ti provides strength and toughness. Standard metalworking methods can be used to prepare these fiber-reinforced composites from powder blends (hence the designation, microcomposites) and for subsequent processing to finished components. The report reviews the history of the development of these materials and presents data from several sources. Potential applications are indicated. (auth)

9129 (AD-783235) DEHYDRIDING OF TITANIUM ALLOY (Ti-6246) HYDRIDED POWDER. Final Report, March–October 1973. Birla, N.; Depierre, V. (Cincinnati Univ., Ohio (USA)). Jun 1974. 34p. (AFML-TR-74-31). NTIS $3.25.

A systematic investigation of temperature–pressure–time variables for dehydriding titanium alloy (Ti-6246) powder was made to determine practical processing conditions for reducing the hydrogen content of the powder to levels below 100 ppM. Analyses of the experimental results of tests made between 1200 and 1500°F indicate that 1500°F is the optimum dehydriding temperature. The controlling process for dehydriding can be expressed by second-order reaction $2H(gas) = H_2(gas)$ with an activation energy of 21,760 ± 1840 cal. Below 0.088 μ partial pressure of hydrogen, the type of vacuum system used for dehydriding is believed to be the major factor for removal of these molecules. (auth)

9130 (BNWL-SA-5059) SPUTTER DEPOSITION AS A REPLICATING TECHNIQUE. Arrowsmith, H. W.; Allen, R. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 16p. (CONF-740812-7). Dep. NTIS $4.00.

From 7th annual international Metallographic Society technical conference; Gatlinburg, Tennessee, USA (4 Aug 1974).

Metal replicas formed by the high-rate sputter deposition of silver onto etched metallographic surfaces have been used to facilitate the optical and SEM examination of radioactive specimens. The sputtered silver is intrinsically featureless at magnifications up to 20,000X, permitting the reproduction and resolution of all significant microstructural details including microcracks and fine porosity. The sputtered metal replicas are prepared using a supported-discharge (triode) cathodic etcher equipped with a silver target. This permits the direct replication of freshly ion-etched surfaces as well as the replication of conventionally-etched specimens. The metal replicas are normally 1 to 10 μm thick and require 2 to 20 min to deposit. The thicker sputtered layers can be stripped from the specimen surface using double-coated tape to provide a durable negative replica of the etched structure. Alternatively, the surface of 1 to 2 μm thick deposits can be examined directly in an SEM (or optically) with the sputtered layer serving as a containment barrier for radioactive or toxic material or to inhibit oxidation of the etched structure. Advantages of the sputtered metal replicas over conventional acetate replicas for SEM studies include high electrical conductivity, immunity to electron-beam damage, and enhanced resolution of microstructural details. (auth)

9131 (CONF-741043-1) PREPARATION AND CHARACTERIZATION OF ACTINIDE TARGETS. Adair, H. L.; Kobisk, E. H. (Oak Ridge National Lab., Tenn. (USA)). 1974. 24p. Dep. NTIS $4.25.

From third annual conference on the nuclear target development society; Chalk River, Ontario, Canada (1 Oct 1974).

Many well-defined actinide samples were prepared by the Isotopes Research Materials Laboratory by either the vacuum evaporation of the oxide or by the vacuum reduction-distillation process. Specific examples of targets produced and capabilities are described and many of the methods of accurately determining isotope concentration and uniformity were described. (6 tables, 11 figs.) (auth)

9132 (LBL-3103) QUANTITATIVE MEASUREMENTS OF PHASE TRANSFORMATION KINETICS IN LOW ALLOY STEELS DURING PROGRAMMED COOLING. Yuen, J. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1974. Contract W-7405-eng-48. 50p. Dep. NTIS $5.50.

Thesis.

The transformation kinetics during the programmed cooling of several low alloy steels in wire form were studied using a magnetic permeability. The specimens in the core of an inductor coil were cooled from the austenitizing temperature along a number of different programmed cooling paths. As the austenite decomposes, the permeability increases which in turn changes the resonant frequency of the inductor coil circuit. The period of the inductor coil circuit was continuously recorded, providing a sensitive record of the transformation kinetics. Continuous cooling transformation diagrams for AISI 4340 and AMS 6416 (300-M) were compared with published diagrams. Certain time–temperature paths for these alloys resulted in the retention of large amounts of austenite at room temperature. (16 fig) (auth)

9133 (RFP-2235) STUDY OF HOMOGENIZATION RATES IN PLUTONIUM–1 WEIGHT PERCENT GALLIUM ALLOY AS A FUNCTION OF PERCENT REDUCTION BY COLD ROLLING. Erfurdt, R. J. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 18 Oct 1974. Contract AT(29-1)-1106. 35p. Dep. NTIS $4.00.

Isostatic pressing for 30 minutes at 85,000 psi was used to determine the effect of cold rolling on the homogenization rates of Pu–1 wt.% Ga alloy. A curve of density versus Ga content was determined for 10 homogenized and isostatically pressed Pu–Ga alloys between 0.1 and 1.0 wt.% Ga. It was determined that delta phase Pu–Ga alloys below 0.7 wt.% Ga are partially transformed to alpha phase when isostatically pressed at room temperature to 85,000 psi. Samples from a Pu-1 wt.% Ga alloy ingot, rolled to 0, 10, 30, 50, 70, and 90% reduction, were homogenized for various lengths of time at 450°C. Curves of isostatically pressed density versus homogenization time were generated for each percent reduction. Four levels of homogeneity, 25, 50, 75, and 90%, were evaluated. Each level of homogeneity was represented by an isostatically pressed density. Homogenization time as a function of percent reduction was generated for each degree of homogeneity. (31 figs, 4 tables) (auth)

9134 (SAND-74-5218) METAL-MATRIX COMPOSITES OF CLOSED GEOMETRIES. Moss, M.; Hoover, W. R.; Schuster, D. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 23p. (CONF-740840-1). Dep. NTIS $4.25.

From 21st sagamore army materials research conference on advances in deformation processing; Raquette, New York, USA (13 Aug 1974).

Procedures are described for fabricating Borsic filament-reinforced aluminum-alloy composites of closed circular geometry. Two circumferentially reinforced shapes are considered: a thick-walled right circular cylinder and a thin-walled conic section. The parts were fabricated by plasma spraying the alloy over hoop-wound Borsic filament, and then densifying in ways which avoided damage to the brittle filament. Axial compaction of the cylinder resulted in a fully dense part without degradation of the Borsic. The conic section was densified by the radial thermal expansion of an aluminum die that forced a semiliquid matrix alloy between the filaments. Properties were measured by ultrasonic and mechanical methods. (auth)

9135 SINGLE–SOURCE EVAPORATION OF GADOLINIUM–COBALT ALLOYS. Taylor, R.C. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Vac. Sci. Technol. 11: No. 6, 1148-1150 (Nov 1974).

A study was made of the feasibility of using single–source electron gun evaporation for the preparation of amorphous Gd–Co alloy films. The sources used covered the compositional range from $Gd_{0.20}Co_{0.80}$ to $Gd_{0.60}Co_{0.40}$. The films deposited from each source were analyzed and the results compared with those expected for ideal alloys based on calculations using Raoult's law and Langmuir's equation. It was found that real alloys gave films with compositional gradients more than twice as severe as would be expected from ideal alloy calculations. In order to obtain films with compositional variations of one percent or less, the evaporation must consume no more than one percent of the source material. (auth)

9136 PRODUCTION OF DUCTILE WELDED JOINTS BETWEEN VANADIUM AND STEEL. Gonserovskii, F. G. Svar. Proizv.; No. 12, 10-12(Dec 1972). (In Russian).

Physical metallurgy of the Fe–V system is discussed, and results of an experimental study on the microstructure, distribution of the elements, and mechanical properties of welds between V (and V-alloy VV8) and steels EP56 and Kh18N12T are presented. The welds made by electron-beam welding using a filler metal of a composition close to that of the welded steel, and with a welding rate greater than 20 m/h were of high ductility and impact strength. (Metals Abstr.)

9137 PROBLEMS IN WELDING VT20 ALLOY IN A CONTROLLED ATMOSPHERE. Gorshkov, A. I.; Matyushkin, B. A.; Ol'khovik, R. G.; Afanes'ev, R. S.; Bekreneva, E. V. Svar. Proizv.; No. 3, 20-22(Mar 1973). (In Russian).

Mechanical properties of welded joints of Ti-alloy VT20 (thickness 1–5 mm) containing Al 5.7–6.4, Mo 0.8–1.2, V 0.55–1.2, and Zr 1.9–2.4% were investigated, as was the effect of a shielding atmosphere (Ar) on the content of gases in the weld metal. The welded joints were made either by manual arc-welding in a chamber filled with Ar at a pressure of 2×10^{-3} to 2×10^{-4} torr, by automatic Ar shielded-arc-welding. Results show that the strength of the joints is ~20% of that of the parent metal, while their impact strength is higher by 1.6–2 kg/cm^2 than that of the parent metal; in the case of manual welding when the Ar had not been purified, an increase of O and N, and a reduction of H in the weld metal occurred. (Metals Abstr.)

9138 POWDER METALLURGY OF TUNGSTEN. Conde, V. Ing. Ind.; 450: 69-72; 74; 76-78; 80(Jun 1973). (In Spanish).

Continuous and discontinuous chip formation as it affects tool wear and/or edge build-up in the case of sintered WC lathe tools were studied. Cutting speed, macrostructure of tool and part materials, welding and phase transformations of the materials, crater formation, diffusion phenomena and related factors are covered. Microphotographs and charted data pertaining to parts of 1050, 1045 and 1060 steel machined, respectively by tools of P 30, K 40 and P 40 carbides, are included. (Metals Abstr.)

9139 ELECTRON BEAM WELDING OF NIOBIUM TO MOLYBDENUM. Gurevich, S. M. Avtomat. Svarka; No. 8, 65-68 (Aug 1973). (In Russian).

100 × 3 × 1 mm sheets and 4-6 mm dia rods of electron beam remelted Nb and a Mo alloy were butt welded and the composition of the weld metal related to the properties of the weld. To eliminate cracking, the Nb and Mo contents should be restricted to 20 and 30% respectively when welding TsM6 and NVCh type alloys, and to 12 and 19% in the case of VMID and VN2A alloys. (Metals Abstr.)

9140 SURFACE DEPOSIT WITH FINE TOUGH STRUCTURE OBTAINED FROM THE NEW ELECTRODE E-B 531 (D6). Kalita, B. Avaranie; 21: No. 8, 245(Aug 1972). (In Czech).

The carbide components in the new E-B 531 electrode are in such a proportion as to ensure long life of the welded-on sections through their resistance to abrasion, pressure, and impacts. The chemical composition of the weld metal is as follows: C 2.90, Si 2.80, Cr 14.0, Mo 1.30, W 4.0, V 1.10, Cu 1.0, and Zr 0.10%. The fine but tough structure formed by the carbide phase of ledeburitic arrangement in the basic austenitic mass is improved mainly by Zr. In natural conditions the weld metal is self-hardening, with a hardness of 1 100 HV30, i.e. approx. 70 HRC. The E-B 531 electrode is particularly suitable for machinery exposed to great strain, pressure, impacts, shearing stress, aggressive agents, or high temperature. (Metals Abstr.)

9141 TITANIUM-TUNGSTEN COATINGS ON A HIGH CHROMIUM STEEL. Yakhnina, V. D.; Vetchanina, L. I. Zashch. Pokrytiya Metal.; No. 7, 113-116(1973). (In Russian).

Ti–W coatings were produced on Armco Fe, and the ferritic Cr alloy steel 0Kh17 [C $\ngtr$ 0.08, Cr 16–18%] by saturation at 800-1100°C for 3 h in powders containing Ti and W, Al_2O_3 inert filler, and NH_4Cl (0.5-7.0) or NH_4I (1.0%) as activators. The reaction mass was covered with charcoal and sealed with a low mp silicate glass. The process is most effective when the container is put into a cold furnace and then brought up to temperature slowly; rapid heating by loading directly into a hot furnace is not recommended. Max depths and max values of microhardness (H_{50} = 1150 kg/mm^2 occur with slow heating to 1000°C. NH_4Cl had no technical advantage over NH_4I, and similar results were given by NH_4Cl in the range 1-5%. The microhardness of the diffusion layer on the Cr steel was higher than that on Armco Fe. (Metals Abstr.)

9142 ELECTROLYTIC BORO-CALORIZING OF STEELS. Venevtsev, S. Ya.; Pasechnik, S. Ya.; Korotkov, V. D.; Ryazhskikh, K. B. Zashch. Pokrytiya Metal.; No. 7, 135-137(1973). (In Russian).

New processes are described for the separate and successive electrolytic saturation of steel surfaces with B and Al from melts. Such coatings exhibit good wear and oxidation resistance. For B saturation, melts based on B and boric anhydride were used, while for calorizing 100% cryolite, or cryolite melts containing $Al_2O_3 \leq$ 40%, or melts containing mainly cryolite with B and Al_2O_3 additions were satisfactory. Microhardness and phase compositions were determined with respect to the bath compositions. The microhardness of boro-calorized layers differed from that of borided layers; the surface layer had a zone of reduced microhardness of 900-1000 kg/mm^2 (aluminides) beneath which there was a zone of Fe boride alloyed with Al, with a microhardness 200-300 kg/mm^2 greater than that of borided layers; below this the microhardness decreased regularly to 300-400 kg/mm^2 at the coating/metal interface. This value decreased with increase in melt temperature and with increase in Al_2O_3 in the melt. Such results, together with those for successive B and then Al coatings, established the possibility of a wide range of physico-mechanical and chemical properties of the diffusion layers depending on the electrolyte composition and deposition regimes. (Metals Abstr.)

9143 ALLOYING OF STEEL TO REDUCE THE TENDENCY TO SOFTENING DURING WELDING. Gulyaev, A. P.; Astaf'ev, A. S.; Matsnev, E. P. Svar. Proizv.; No. 3, 8-9(Mar 1973). (In Russian).

The alloying of a high-strength steel containing C 0.23–0.27% with elements (Si, Cu, Mo, or V) which inhibit tempering reduced the tendency of the metal in the heat-affected zone to softening during welding. To prevent embrittlement of the heat-affected zone, steels should be used in a highly tempered condition. The tempering temperature of the steel should be above the temperature which yields the max hardness of the parent metal. (Metals Abstr.)

9144 ELECTROPLATING WITH TANTALUM. Metalloberflaeche; 27: No. 12, 459-460(Dec 1973). (In German).

The electrodeposition of Ta from a molten salt bath and the properties of the coatings obtained are described. Deposition is carried out at 750-850°C under a protective atmosphere. The rate of deposition is 40 μm/h. (Metals Abstr.)

9145 INFLUENCE OF MOLYBDENUM AND TUNGSTEN ON THE RESISTANCE OF WELDS TO SOLIDIFICATION CRACKING. Leinachuk, E. I.; Podgaetsky, V. V.; Parfessa, G. I. Avtomat. Svarka; No. 11, 9-13(Nov 1973). (In Russian).

W and Mo additions to weld metal reduce the tendency to solidification cracking. The improvement is at a max with 11-14% Mo and >18% W. These alloying elements modify the size of the sulfide inclusions, and form carbides, and a carbide eutectic. (Metals Abstr.)

9146 COMPARATIVE ASSESSMENT OF THE PROPERTIES OF NICKEL-CHROMIUM METAL DEPOSITED BY ARGON-ARC-AND ARC-WELDING WITH COATED ELECTRODES. Sorokin, L. I. Svar. Proizv.; No. 3, 24-26(Mar 1973). (In Russian).

A comparative study was made of the strength and ductility (at 20 and 800°C) as well as the resistance to hot cracking in Ni–Cr alloy containing Mo 0-26, W 0-21, and Nb 0-11% deposited on plates of EI 435 alloy by Ar-arc welding or by arc welding in which alloying with Mo, W, and Nb was accomplished by the use of coated electrodes. When compositions of the deposited metal were identical, Ar-arc welding gave a higher resistance to hot cracking and better mechanical properties of the deposited metal than did arc welding. (Metals Abstr.)

9147 SOME TRENDS IN THE DEVELOPMENT OF MOLYBDENUM–CONTAINING TOOL STEELS IN THE USSR. Poznyak, L. A. Metallurgia; 40: No. 11, 345-346(Nov 1973).

In recent years a trend towards replacing high-W tool steels with complex alloyed grades having higher Mo contents has been evident in the U.S.S.R. The beneficial effect of Mo on the structure and mechanical properties of tool steels is discussed, and compositions recommended for hot-work and cold-work die steels are given. (Metals Abstr.)

9148 PRODUCTION OF URANIUM METAL. Briggs, G. G. (to United States Atomic Energy Commission). South African Patent 256,065. 25 Apr 1973. Priority date 6 Jul 1972, USA. 19p.

A process is given for preparing $NaF.2UF_4$ suitable for reduction to uranium metal. The process comprises the steps of reacting uranyl chloride in an aqueous solution containing sodium ions, hydrofluoric acid, quadrivalent sulfur, and a copper sulfate catalyst to produce $NaF.2UF_4$, and separating said $NaF.2UF_4$ from other reaction ingredients. (INIS)

9149 PECULIARITIES OF THE PROCESS OF COMBINED HYDROGEN REDUCTION OF IRON AND TUNGSTEN OXIDES. Radomyselskii, I. D.; Barshchevskaya, L. F.; Vlasyuk, R. Z. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 14-20(Oct 1974). (In Russian).

Phase composition of hard products after reduction of iron and tungsten oxides mixtures and the chemical compound Fe_2WO_6 formed during calcination of this mixture in the air was studied by x-ray diffraction. Interaction of iron and tungsten oxides accompanied by formation of the complex oxide of the $FeWO_4$ type with a spinel structure and its further reduction are shown to be peculiar to the process of combined reduction of these oxides. Reductions of a mechanical mixture of iron and tungsten oxides and their chemical compound were observed to be analogous, which is confirmed by kinetics of the latter and the same value of the apparent activation energy. A scheme is suggested for the reduction mechanism of iron and tungsten oxides and the chemical compound. (auth)

9150 USE AND PRODUCTION OF CADMIUM ELECTRODEPOSITS. Walker, R. Metal Finish.; 12: No. 1, 59-64(Jan 1974).

Cadmium is widely used to cover Fe and steel and it has certain advantages over Zn in specific applications. The Cd surface has a high corrosion resistance in some atmospheres, and it also gives cathodic protection to steel substrates at discontinuities in the coating. Many plating solutions can be used to produce satisfactory coatings, and the coating parameters for using these solutions are reviewed. Properties of the deposits formed are discussed together with some of the factors that may affect the choice of the bath, e.g. surface quality, the throwing power of the solution and the possibility of H embrittlement. (Metals Abstr.)

9151 HEAT TREATMENT OF BERYLLIUM COPPER ALLOYS. VI. Other Heat Treating Processes for Be–Cu Alloys. Wikle, K. G. Ind. Heat.; 40: No. 12, 41; 43; 45; 47–48; 51(Dec 1973).

Bulk homogenizing, strand homogenizing, stress relieving, and mill heat treating methods for Be–Cu alloys are reviewed. The common problems encountered in precipitation hardening of Be–Cu are then discussed, with emphasis on the control of warping and distortion. (Metals Abstr.)

9152 NEW PROCESSES FOR OBTAINING INCREASED METAL HARDNESS AND REDUCED FRICTION PROPERTIES BY BORONIZING. I. Linial, A. V.; Lavella, J. P. Ind. Heat.; 40: No. 12, 9-12; 14(Dec 1973).

The Borkote process produces a hardened case with a very low coefficient of friction on the surfaces of all steels, Ti, Cr, Mn, Co, Mo, Ta, and W. The case consists of only one boride phase and a secondary supporting layer. Applications include dies, cams, scrapers, punches, hubs, jigs, quarry tools, shear blades, bushings, bearings and powder metal parts. (Metals Abstr.)

9153 M AND P [MATERIALS AND PROCESSES] GLANCE AT THE F-15 AIRCRAFT. Young, G. C. SAMPE J.; 9: No. 5, 10-12(1973).

The F-15 aircraft has a forward structure of Al and an aft structure of Ti. The Ti–6Al–4V alloy is used for fatigue-critical applications and the 6Al–6V–2Sn alloy for strength-critical areas. The wing structure is basically Al alloys 2124, 7075, and 7175 except for some spars and panels of annealed Ti alloy. Forgings of Ti–6Al–4V alloy form the bulkheads. Torque box skins on the stabilators are made of a B/epoxy composite. (Metals Abstr.)

9154 ELECTRON BEAM WELDING OF NIOBIUM WITH MOLYBDENUM. Gurevich, S. M.; Zaderij, B. A.; Kharchenko, G. K.; Shevchuk, T. V. (AN Ukrainskoj SSR, Kiev. Inst. Ehlektrosvarki); Ponimash, I. D.; Garanin, Yu. P. Avtomat. Svarka; No. 8, 65-68(Aug 1973). (In Russian).

For English translation see the journal Autom. Weld.

The tendency of welded compounds of Nb and Mo to form fissures as a function of the composition of the seam was studied. In order to obtain welded compounds of Mo with Nb without fissures it was necessary to control rigidly the concentrations of these metals in the seam; the limitation is 20% Nb and 36% Mo in welds of alloys comparatively from impurities and 12% Nb and 19% Mo in less pure alloys. The selection of the method, range of control of the chemical composition of the metal of the seam, and the welding conditions were determined in each specific case by the construction of the product and the composition of the composite materials. The dependence of the microhardness on the chemical composition of the metal of the seam can be used for its operational appraisal and control. (tr-auth)

9155 ELECTRODEPOSITION OF CADMIUM FROM SULFURIC ACID ELECTROLYTES CONTAINING NEW SURFACE-ACTIVE ADDITIVES. Vysotskaya, N. A.; Vakhidov, R. S. (Kazakh Chemicotechnological Inst., Alma-Ata, USSR). Prot. Metals (USSR) (Engl. Transl.); 10: No. 2, 175-176(1974).

Translated from Zash. Metal.; 10: No. 2, 185-187(1974).

The influence of P- and S-containing surfactants of the BGU type was studied in conjunction with gelatin additions. The additions increased the cathodic overvoltage of Cd deposition, especially for BGU-36 + gelatin; the resulting coatings are denser and better from the decorative point of view. It is proposed to apply high-quality Cd galvanic coatings from sulfate electrolyte with BGU-36 additions. (DLC)

9156 ELECTRODEPOSITION OF INDIUM–TIN ALLOYS. Mogilev, V. M.; Falicheva, A. I. (Voronezh Polytechnical Inst., USSR). Prot. Metals (USSR) (Engl. Transl.); 10: No. 2, 182-183 (1974).

Translated from Zash. Metal.; 10: No. 2, 192-194(1974).

In order to coat large surfaces, the possible deposition of In–Sn alloys from boron-hydrofluoride electrolyte was studied. Conditions for obtaining dense, silvery, fine-crystal deposits of alloys containing up to 16% Sn were determined: 44 g/l $In(BF_4)_3$, 4.5 g/l $SnCl_2 \cdot 2H_2O$, 10 to 15 g/l free HBF_4, 10 to 15 g/l boric acid, 5.5 to 6 g/l NH_4F, 20 g/l NH_4HF_2, electrolyte temperature 18 to 25°, current density 2.5 to 5 A/dm^2, pH 1.0 to 1.1. (DLC)

9157 PREPARATION OF HIGH-PURITY LITHIUM BY A GETTERING TECHNIQUE. Weed, H. C.; Krikorian, O. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). J. Nucl. Mater.; 52: No. 2, 142-156(Oct 1974).

Gettering with yttrium or cerium at 1100°K was used to prepare high-purity lithium for subsequent use in the preparation of lithium hydride. Yttrium decreased the average oxygen concentration in lithium to about 15 atomic ppM O; lithium hydride prepared from this lithium contained from 30 to 140 atomic ppM O. Carbon concentration in lithium was not affected by gettering with yttrium or cerium. Carbon and oxygen concentration were determined by photoactivation using gamma rays produced in a high electron energy linear accelerator. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 8539, 9955, and 10315.

9158 (AD-733677) MICROSTRUCTURE AND STRENGTH PROPERTIES OF UNIDIRECTIONALLY SOLIDIFIED COBALT–NIOBIUM EUTECTIC ALLOY. Gudas, J. P. (Naval Ship Research and Development Center, Annapolis, Md. (USA)). Nov 1971. 77p. (NSRDL/A-8-918). NTIS $3.00.

Room-temperature (RT) mechanical properties of unidirectionally solidified Co–Co_3Nb eutectic alloy have been studied. Solidification rates varying from 0.000128 to 0.001764 cm/sec were employed in producing various microstructures. A well-defined lamellar microstructure is produced at rates below 0.000317 cm/sec, while above this rate a lamellar-dendritic structure exists. RT compression and hardness tests indicated increased strengthening with increasing solidification rate as well as verification of a Hall–Petch dependence of fracture stress and hardness upon interphase spacing. Brittle fracture in both types of structure was seen to be initiated by slip in the ductile Co_3Nb phase and promoted by crack propagation in the brittle alpha-cobalt solid solution phase. (auth)

9159 (AD-771383) ENGINEERING EVALUATION OF THE PRESTRESS/SURFACE REMOVAL TECHNIQUE FOR FATIGUE OR CREEP ENHANCEMENT. Final Report, 14 June 1972–14 June 1973. Sippel, G. R.; Herman, M.; Nichols, E. S. (General Motors Corp., Indianapolis, Ind. (USA). Detroit Diesel Allison Div.). Aug 1973. Contract N00019-72-C-0458. 42p. (DDA-EDR-7862). NTIS $3.00.

Compressor blades of annealed Ti 6Al–4V alloy were step fatigue tested in the fundamental mode to determine the effect of a prestress-surface removal treatment on the 10^7 cycle fatigue strength. Prestressing the blades in axial tension at 80-100 ksi and stress relaxing at ambient temperature, improved the average 10^7 cycle fatigue strength up to 60%. Residual surface stresses on the blades, measured before and after prestressing, showed a residual compressive stress due to prestressing. Glass bead peening failed to improve the annealed blade fatigue strength. Practical methods for prestressing blades must be developed for production application of this process. The prestress-surface stress removal treatment was not effective in reducing the secondary creep rate of cast nickel base MAR-M246 alloy material at realistic turbine blade temperatures and stresses. (auth)

9160 (AD-779033) RESEARCH TO INVESTIGATE THE AGING CHARACTERISTICS OF SAMARIUM–COBALT MAGNETS. Final Report, 1 July–14 December 1973. Mildrum, H. F.; Strnat, K. J. (Dayton Univ., Ohio (USA). Research Inst.). Mar 1974. Contract F33615-72-C-1795. 113p. (UDRI-TR-74-18). NTIS $4.50.

The research investigations into the aging characteristics of samarium-cobalt magnets were formulated to provide objective information on the sensitivity of the magnetic properties to: (1) variables in the basic magnet manufacturing processes; (2) storage under varying conditions; (3) processing of the magnets into usable configurations; and (4) usage under various adverse thermal, mechanical, and demagnetizing loads representative of the environmental conditions likely to be encountered by the magnets in device applications. (GRA)

9161 (AD-779530) CRYSTAL FIELD INTERACTIONS AND MAGNETIC ANISOTROPY IN LANTHANIDE INTERMETALLICS. Final Report, 4 January 1965–3 January 1974. Wallace, W. E.; Craig, R. S. (Pittsburgh Univ., Pa. (USA). Dept. of Chemistry). 15 Apr 1974. 17p. (AROD-5375.23-MC). NTIS $3.00.

The major experimental approach is the study of low-temperature heat capacities which leads to an evaluation of the crystal-field interaction. The effect of alloying on the anisotropy of R_2Co_{17} compounds is presented for a number of systems. The theoretical work carried out, making use of the operator equivalent method, enables one to predict the sign of the anisotropy for RCo_5 compounds. (DLC)

9162 (AD-779719) RARE EARTH COBALT SINGLE CRYSTALS. Final Report, 1 January–31 December 1973. Austin, A. E.; Miller, J. F. (Battelle Columbus Labs., Ohio (USA)). Feb 1974. Contract F33615-73-C-5038. 35p. (AFML-TR-74-28). NTIS $3.25.

Single crystals of $Sm_{1-x}Pr_xCo_5$ and $Y_{1-x}Nd_xCo_5$ were grown for $x = 0.25$, 0.50, and 0.75. Crystals of $Gd_{0.33}Nd_{0.67}Co_5$ and $Gd_{0.5}Nd_{0.5}Co_5$ and $Sm_2Fe_{4.24}Co_{12.75}$ were also grown. Conditions for crystal growth are summarized. Data are reported on magnetic domains, unit cell lattice constants, compositions, and inclusion phases for these systems. (auth)

9163 (AD-779745) OPTICAL PROPERTIES OF SEMICONDUCTORS AND METALS. Final Scientific Report, 1 January 1969–31 May 1974. Tzoar, N.; Gersten, J. I. (City Coll., New York (USA)). 31 May 1974. 31p. (AFOSR-TR-74-0777). NTIS $3.00.

Investigations were conducted on interaction of electromagnetic radiation with solids. In particular, the electronic structure and the linear and nonlinear optical properties of semiconductors and metallic surfaces were studied. Research on metallic surfaces centered upon the photoemission phenomenon. The study involved calculating the high-frequency dielectric properties of semiconductors including electronic and ionic fluctuations, anisotropy effects, magnetic fields, impurities, and band structure using appropriate generalizations of the many-body perturbation method. (DLC)

9164 (AD-783263) SUBCRITICAL CRACK GROWTH UNDER SUSTAINED LOADING AS AFFECTED BY STRESS MODE AND CORROSIVE ENVIRONMENT. Final Scientific Report. Williams, D. N. (Battelle Columbus Labs., Ohio (USA)). 12 Jul 1974. 13p. (AFOSR-TR-74-1223). NTIS $3.00.

Subcritical crack growth under sustained load in a Ti–4Al–3Mo–1V alloy was investigated using compact tension specimens under constant load. Crack growth sufficient to cause failure in less than one week was observed at initial stress intensities as low as 0.45 K_c. Subcritical crack growth was not attributable to stress corrosion; it occurred more readily in vacuum than in salt water. Since the alloy was stabilized in vacuum prior to test, metallurgical instability also appears an unlikely contributory factor. Tests of specimens of several thicknesses having variable degrees of triaxial loading across the crack front suggest that subcritical crack growth is controlled by the combined influences of creep in the uncracked surface region under plane stress loading and strain-dependent plane strain fracture in the central region and triaxial loading. (GRA)

9165 (AECL-4660) HIGH TEMPERATURE MECHANICAL TESTS ON Zr_3Al-BASED ALLOYS. Bell, L. G.; Cameron, D. J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jul 1974. 26p. Dep. NTIS (US Sales Only) $4.50. AECL $1.00.

Creep, tensile, and hot-hardness tests were performed on Zr_3Al-based alloys with 7 to 9.5 wt % Al. Creep properties at 400°C were very good with creep rates about 100 times lower than those of cold-worked Zr–2.5% Nb under the same conditions. Mechanical properties varied with Al concentration but the results were inconsistent. Creep rates determined as a function of temperature at a stress of 207 MPa gave an activation energy for creep of 0.205 MJ/mole (49,000 cal/mole). (10 figures) (auth)

9166 (BMFT-FB-T-73-07) CERAMIC/METAL BONDS WITH IMPROVED PROPERTIES. Schickfluss-Borges, E. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany); Zentralstelle fuer Luft- und Raumfahrtdokumentation und -Information, Muenchen (F. R. Germany)). Jun 1973. 82p. (In German).

The investigations covered three main aspects: (1) development and proving of new testing methods; (2) simplification and improvement of conventional Mo–Mn process; and (3) production of ceramic/metal bonds with the aid of interfacially active metals. (GE)

9167 (BMFT-FB-T-73-08) FIBER-REINFORCED MATERIALS WITH METAL MATRIX. Gruenling, H. W. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany); Zentralstelle fuer Luft- und Raumfahrtdokumentation und -Information, Muenchen (F. R. Germany)). Jun 1973. 93p. (In German).

Investigations are described on systems of Ni and Ni–20 Cr as matrix materials using Al_2O_3 and SiC fibers and whiskers, as well as W and Mo wire, as fiber materials. (GE)

9168 (BNL-16574) HIGH CYCLE FATIGUE PROPERTIES OF LMFBR MATERIALS. Chow, J. G. Y. (Brookhaven National Lab., Upton, N. Y. (USA)). 21p. (CONF-720622-4). Dep. NTIS $4.25.

From symposium on fatigue at elevated temperatures; Storrs, Connecticut, USA (18 Jun 1972).

The materials tested were Type 304 stainless steel, Incoloy 800, and 2¼ Cr–1 Mo ferritic steel. S-N curves for tests up to 1100°F and for 10^4 to 10^{10} cycles to failure are presented. MTS systems machine operating at 40 cps were used for tests up to 10^8 cycles and the ultrasonic vibration test operating at 20,000 cps was used for higher cycle range to failure. It was found that the failure processes for the two methods of testing is not identical and this is reflected in the different levels of stress required for overlapping cycles to failure. In the 10^7 to 10^8 cycle range, the stresses for the ultrasonic test to produce failure is approximately 50% lower than in the MTS test method. Results demonstrate the necessity of failure mechanism studies in conjunction with fatigue testing. (7 fig) (auth)

9169 (BNL-19264) NEUTRON INDUCED DISORDER IN SUPERCONDUCTING A-15 COMPOUNDS. Sweedler, A. R.; Cox, D.; Schweitzer, D. G.; Webb, G. W. (Brookhaven National Lab., Upton, N. Y. (USA)). 30 Sep 1974. 8p. (CONF-740957-20). Dep. NTIS $4.00.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

Effect of high-energy neutron ($E > 1$ MeV) irradiation at 60°C on the superconducting critical temperature, T_c, the upper critical field, H_{c2}, the lattice parameter, a_0, and the degree of long-range order was measured for Nb and V-based A-15 superconducting compounds. Large reductions in T_c and H_{c2} were observed for fluences up to 5.0×10^{19} n/cm². For Nb_3Al, a_0 increases and the degree of long-range order is significantly reduced as T_c is depressed. Results are discussed in terms of atomic ordering in the A-15 structure. (auth)

9170 (BNL-19270) INVESTIGATION OF MICROWAVE PROPERTIES OF SUPERCONDUCTING $Nb_{0.4}Ti_{0.6}$. Giordano, S.; Hahn, H.; Halama, H. J.; Luhman, T. S.; Bauer, W. (Brookhaven National Lab., Upton, N. Y. (USA)). 30 Sep 1974. 8p. (CONF-740957-10). Dep. NTIS $4.00.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

A superconducting $Nb_{0.4}Ti_{0.6}$ test cavity was constructed to measure the surface losses at 2 to 8 GHz below 4.2°K. The temperature-dependent part of the surface resistance agrees with the BCS theory if the material parameters are $T_c = 9.8$°K, $\Delta(0) = 1.73\, k_BT_c$, $\xi_0 = 380$ Å, $\lambda_L = 310$ Å, and $l = 4$ to 8 Å. The magnitude and frequency dependence of the temperature-independent residual resistance suggest no difference in the behavior of type I and II superconductors. The highest $Q_0 = 2.9 \times 10^9$ was measured in the TE_{011} mode at 3.9 GHz. A coaxial cavity with removable sample was constructed for an in-depth study of rf breakdown and its relation with metallurgical parameters as characterized by ac loss, magnetization, and penetration depth measurements. Peak fields in solid type-II superconducting cavities are limited by their low thermal conductivity suggesting the use of films, 0.01 to 0.1 mm thick, on pure niobium or copper. The highest magnetic field of 120 G was measured on a recrystallized sample suggesting that the lower critical field H_{c1} (for this sample 75 G) does not prevent the application of high-T_c type-II superconductors to microwave devices. (auth)

9171 (CONF-7309123-(Absts.)) FIRST ALL-UNION CONFERENCE ON THE PHYSICS AND TECHNIQUES OF HIGH PRESSURE, DONETSK, USSR, SEPTEMBER 5–7, 1973. Abstracts. (AN Ukrainskoj SSR, Donetsk. Fiziko-Teknicheskij Inst.). 1973. 218p. (In Russian).

Abstracts of the papers presented at the Conference are compiled. The topics discussed include the basic physics of high pressure, experimental apparatus and techniques, hydroextrusion, electron properties under high pressure, magnetic properties under high pressure, lattice dynamics and spectroscopy under high pressure. (JSR)

9172 (CONF-740738-1) INVESTIGATION OF ELECTRON LIFETIMES IN MOLYBDENUM WITH DILUTE SUBSTITUTIONAL IMPURITIES. Arko, A. J.; Mueller, F. M. (Argonne National Lab., Ill. (USA)). [nd]. 20p. Dep. NTIS $4.00.

From international conference on electron lifetimes in metals; Eugene, Oregon, USA (8 Jul 1974).

Electronic local scattering rates were measured in Mo containing W, U, Ru, and Fe impurities by the de Haas–Van Alphen effect. Effective mass and Dingle temperature measurements were made. Anisotropies are discussed. The scattering matrix element per impurity is 0.685, 0.705, 0.711, and 0.094 eV per impurity of Ru, Fe, U, and W, respectively; thus, Ru and Fe have an excess of two electrons (2e) compared to Mo, U has a deficiency of 2e, and W is homovalent. (DLC)

9173 (CONF-740847-1) ANALYSIS OF HOLD TIME FATIGUE TEST RESULTS OF AISI 304 STAINLESS STEEL BY FIVE EXISTING METHODS. Kitagawa, M.; Weeks, R. W. (Argonne National Lab., Ill. (USA)). 1974. 15p. Dep. NTIS $4.00.

From symposium on mechanical behavior of materials; Kyoto, Japan (21 Aug 1974).

Selected high-temperature (1050, 1100, and 1200°F) fatigue data for AISI 304 stainless steel are analyzed using the linear creep-fatigue damage rules, the frequency modified parameter method, and the method given in ASME Code Case 1331-5. The capability of each method to predict fatigue lives obtained under known testing conditions is discussed. The method of the ASME Code case, which includes large safety factors, was found to be conservative. If, however, the method is used at 1050°F for cycles with long hold times, the safety factor of the resultant design may be significantly smaller than desired. The other four methods examined predicted the majority of the experimental fatigue lives within a factor of two. The linear creep-fatigue damage rule using a time ratio for creep damage appears to be superior to the others. (4 figs) (auth)

9174 (CONF-740956-1) PRODUCTION OF DISPLACED ATOMS IN SOLIDS. Robinson, M. T. (Oak Ridge National Lab., Tenn. (USA)). 1974. 19p. Dep. NTIS $4.00.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

Displacement doses and dose rates produced in solids by irradiation with various sorts of particles are usually estimated by a modification of the Kinchin–Pease model. Several ingredients of this model are surveyed to find areas for further research. Comparisons with experimental data indicate the unsatisfactory nature of present theories of the electronic stopping of low-velocity atomic recoils. Estimates of damage energy may therefore be significantly in error. Computer simulations show that the assumed linear dependence of the number of displacements in a cascade on the damage energy is probably not correct in dense cascades. Details of cascade structure still require elucidation, particularly as they affect the nucleation and growth of voids, gas bubbles, dislocation loops, etc. (52 references) (auth)

9175 (COO-2314-4) EXPERIMENTAL DETERMINATION OF THE TEMPERATURE DEPENDENCE OF METALLIC WORK FUNCTIONS AT LOW TEMPERATURES. Progress Report, March 1, 1974–February 28, 1975. Pipes, P. B. (Dartmouth Coll., Hanover, N. H. (USA). Dept. of Physics and Astronomy). 1974. Contract AT(11-1)-2314. 6p. Dep. NTIS $4.00.

Progress is reported on a theoretical study of a superconducting loop containing a Josephson junction with a temperature gradient across it, initiation of experiments to measure metallic work functions at low temperatures, and a variable temperature cryostat for experiments on the effects of temperature gradients on superconductors. (DLC)

9176 (FOA-4-C-4587) DETERMINATION OF THE DENSITY OF PLUTONIUM. Schill, I.; Soederqvist, R. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Jun 1974. 26p. (In Swedish). Dep. NTIS (US Sales Only) $4.50.

Determination of the density of metal samples of plutonium in the mass interval 0.5 to 15 g was performed in a glove box using the displacement method, with a tetrabromethane and FC-43 (a fluorinated hydrocarbon) as bath liquids. The precision is limited to 0.02 g/cm^3 due to radioactive heating. (SW)

9177 (KFK-2023) DYNAMIC PLASTIC BEHAVIOR OF METALS. Malmberg, T. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Sep 1974. 146p. (In German). Dep. NTIS (US Sales Only) $10.50.

For FBR safety considerations, it is necessary to know the mechanical properties of structural steels and their equivalents used in model experiments. The present study is of phenomena observed in steels with low carbon content (mild steel) and austenitic stainless steels under dynamic plastic deformation. However, dislocation models are not treated. Various constitutive relations used for the analysis of time-dependent plastic flow under uniaxial stress conditions are discussed. Problems related to the interpretation of experiments at higher strain rates ($\dot{\varepsilon} > 10$ sec^{-1}) due to elastic plastic wave interactions are described. (68 figures, 101 references) (auth)

9178 (LA-UR-74-1472) CRITICAL CURRENT DENSITIES IN Nb_3Ge BETWEEN 14 AND 21 K. Bartlett, R. J.; Laquer, H. L.; Taylor, R. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 4p. (CONF-740957-1). Dep. NTIS $4.00.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

Self-field critical current densities of thick Nb_3Ge films were measured at 13.8 to 21°K. Bulk critical current densities J_c above 1.6×10^6 A/cm^2 were observed at 14°K, falling linearly at higher temperatures. Extrapolation to zero critical current gave a critical temperature $T_c \sim 19.2$°K which is ~1.5°K lower than the onset T_c from the ac magnetic susceptibility. The samples were long sections of copper tubes, which had been coated on the inside with Nb_3Ge by chemical vapor deposition. J_c for various high T_c materials are compared including calculations of adiabatic stability. Nb_3Ge holds promise for a dc superconducting power transmission line operating near 14°K. (5 figs.) (auth)

9179 (LA-UR-74-1487) BULK SUPERCONDUCTIVITY ABOVE 20 K IN Nb_3Ge. Newkirk, L. R.; Valencia, F. A.; Giorgi, A. L.; Szklarz, E. G.; Wallace, T. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 30 Sep 1974. Contract W-7405-eng-36. 5p. (CONF-740957-18). Dep. NTIS $4.00.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

Superconducting properties of bulk film (0.02 to 0.06 mm thick) of Nb_3Ge deposited on Cu substrates by chemical vapor deposition were studied along with physical parameters characterizing these deposits. Susceptibility measurements showing superconducting onsets greater than 21°K and resistivity measurements showing onset greater than 22°K are presented along with heat capacity measurements. Data are also presented relating superconducting transition temperature and lattice spacing throughout the range of 4 to 21°K. Effects of substrate temperature and substrate material, as well as mechanical properties such as substrate adherence are described. (9 figures) (auth)

9180 (LBL-3134) DISCONTINUOUS COARSENING DURING AGING IN SPINODALLY DECOMPOSED Cu–Ni–Fe ALLOYS. Gronsky, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1974. 78p. Dep. NTIS $7.00.

Thesis.

Two Cu–Ni–Fe alloys of symmetrical and Cu-rich compositions were subjected to prolonged aging at three temperatures in an attempt to establish the nature of the grain boundary reaction and its relationship with the previously existing spinodal product. It was found that at certain boundary regions, especially those of relatively large grain misorientation, select boundary segments migrate at a rate depending on time and temperature, leaving behind large irregularly shaped particles which assume a cellular morphology. As a result of the combined influence of a dominant driving force (reduction in total interphase interfacial energy) and sluggish boundary migration rate, the particles within the cellular constituent undergo additional coarsening, wherein their effective interparticle spacing (λ_2) varies as $\lambda_2 = k_2 t^{0.7}$, compared to that (λ_1) of the matrix, $\lambda_1 = k_1\ t^{0.34}$. In both cases the rate constant (k) of the asymmetrical alloy is greater than that of the symmetrical alloy. The rate controlling process appears to be that of volume diffusion in the coarsening of matrix particles and has been tentatively associated with boundary migration in the coarsening of the boundary migration product. No satisfactory account of Cu–Ni–Fe discontinuous coarsening reaction kinetics can be made, based upon current theories of thermally activated growth processes. (auth)

9181 (PWAC-356) SOLUBILITY OF STRUCTURAL METALS IN LITHIUM. Leavenworth, H.; Cleary, R. E.; Bratton, W. D. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Jun 1961. Contract AT(11-1)-229. 31p. Dep. NTIS $4.75.

Declassified 15 Jun 1965.

The solubilities of some transition metals in liquid lithium as a function of temperature were determined between 1200°F and 1700°F. The rate of solution of iron in lithium was determined at 1550°F. The effect of nitrogen contamination of the lithium on the solubility of the metals was investigated, and the effect of the relative atomic size on the temperature coefficient of solution was determined. (auth)

9182 (RFP-2240) INFLUENCE OF SAMPLE SIZE AND GEOMETRY ON THE TENSILE PROPERTIES OF BERYLLIUM. Miley, D. V.; Gauger, G. G. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 22 Nov 1974. Contract AT(29-1)-1106. 19p. Dep. NTIS $4.00.

A series of room-temperature tensile tests was performed using circular and rectangular gauge cross sections and using beryllium test bars of varying gauge length and cross-sectional areas. Results show that specimen size is not a significant factor for either the round or the flat bars. Data derived from a common sheet are the same for round as for flat test bars. Only for round specimens having length-to-diameter ratios of less than 4 to 1 did the tensile data show any bias. In such cases the yield strength was biased high; the elongation was biased low. (9 figures, 4 tables) (auth)

9183 (SAND-74-8021) CHARACTERIZATION OF AN ASTM ROUND-ROBIN TUNGSTEN POWDER. German, R. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1974. Contract AT(29-1)-789. 20p. Dep. NTIS $4.00.

Powder characterization results for a fine-sized tungsten powder are reported. Measurements include density properties, specific surface area, particle size and size distribution. Microscopy is used to relate the powder characteristics to the powder condition before and after rod milling. (auth)

9184 (UCRL-51682(Pt.4)) BEHAVIOR OF POROUS BERYLLIUM UNDER THERMOMECHANICAL LOADING. Part 4. Constitutive Model for Wave Propagation. Ree, F. H.; Isbell, W. M.; Horning, R. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Nov 1974. Contract W-7405-eng-48. 47p. Dep. NTIS $4.00.

A new constitutive model for wave propagation in porous materials is constructed. It features (1) inclusion of deviatoric stresses, (2) an option for porosity-dependent relaxation time for pore closure, (3) elastic reopening of the pores, and (4) an improved plastic compaction function. This model was applied to plasma-sprayed porous beryllium in the as-sprayed condition (~14% porosity) and after sintering (~10% porosity). Data from the static and dynamic experiments were correlated. Wave profiles from plate impact experiments were used to test the model. The good agreement between model calculations and wave profiles suggests that the mechanical response of porous beryllium can be satisfactorily described within the necessary accuracy by this model. The effect of an in-material gage on observed wave profiles, and a transient phenomenon affecting the wave profile at the impact surface are also discussed. (auth)

9185 (USIP-73-10) DILUTE Fe:Cu ALLOYS STUDIED BY GAMMA–GAMMA DIRECTIONAL CORRELATIONS. Bargholtz, C.; Beshai, S.; Eriksson, L.; Froeberg, L. E. (Stockholm Univ. (Sweden). Fysiska Institutionen). Oct 1973. 8p. Dep. NTIS (US Sales Only) $4.00.

With sources of dilute Cu–Fe alloys, the gamma-gamma directional correlation of the 142.5–1291.4 keV cascade in ^{59}Co was studied by use of a multichannel goniometer. The angular correlation coefficient was found to be sensitive to the Fe content. (auth)

9186 RELATIVE WORK FUNCTION OF CLEAN MOLYBDENUM SINGLE–CRYSTAL PLANES DETERMINED BY FIELD EMISSION MICROSCOPY. Bergeret, G.; Abon, M.; Tardy, B.; Teichner, S.J. (Institut de Recherches sur la Catalyse, C.N.R.S., 39, boulevard du 11 Novembre 1918, 69100–Villeurbanne, France). J. Vac. Sci. Technol. 11: No. 6, 1195-1195 (Nov 1974).

A probe–hole field emission microscope has been used to determine the work function of clean molybdenum single crystal planes relative to the average work function of the field emitter, assumed to be 4.20 eV. Results obtained are compared with other available data. (AIP)

9187 ENHANCEMENT OF TRANSVERSE THERMOELECTRIC VOLTAGES IN THIN METALLIC FILMS. von Gutfeld, R.J.; Caswell, H.L. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Appl. Phys. Lett. 25: No. 12, 691-693 (15 Dec 1974).

A correlation between the surface morphology of slant–angle deposited films and the magnitude of the transverse thermoelectric voltage has been observed. This finding has been mainly responsible for the fabrication of optical detectors with responsivities greatly enhanced over those previously reported, extending to 10.6 μ and into the cw range. (auth)

9188 PROPERTIES OF IRON IMPURITIES IN BERYLLIUM FROM MÖSSBAUER STUDIES. Janot, C.; Delcroix, P.; Piecuch, M. (Laboratoire de Physique du Solide, Université de Nancey–I–C. O. 140, 54037 Nancy–Cedex, France). Phys. Rev. B 10: No. 7, 2661-2668 (1 Oct 1974).

Beryllium specimens containing 0.012–at. % ^{57}Fe were studied by Mössbauer spectroscopy in the temperature range from 75 to 1200 K. The changes of the recoil–free fraction, the second–order Döppler shift, the isomer shift, the quadrupole splitting, and the peak intensities are reported and interpreted as follows. (i) The effective impurity–host force constant λ' is slightly smaller than the host–host force constant λ ($\lambda'/\lambda \sim 0.96$) and an anharmonic behavior is observed at high temperature. (ii) The main part of the electric field gradient arises from d electrons localized around the impurity atom in a virtual bound state near the Fermi level. (iii) At about 870 K, a short–range diffusion process occurs for iron impurities in as–quenched specimens with progressive annealing of quenched defects. (auth)

9189 CHEMICAL VAPOR DEPOSITION OF SUPERCONDUCTING Nb_3Ge HAVING HIGH TRANSITION TEMPERATURES. Braginski, A.I.; Roland, G.W. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). Appl. Phys. Lett. 25: No. 12, 762-763 (15 Dec 1974).

Superconducting films of Nb_3Ge have been deposited by chemical vapor deposition. Chloride vapors were produced in situ and reduced by hydrogen. The reactor used allowed surveying of phases with varying Nb/Ge ratio. The highest transition onset temperature was 21.7 K with a transition width of 0.4 K. It occurred near the Ge–richest boundary of the Nb_3Ge phase. (auth)

9190 TEMPERATURE DEPENDENCE OF AC LOSSES AND SELF–FIELD CRITICAL CURRENTS IN Nb_3Sn. Bussiere, J.F.; Garber, M.; Shen, S. (Power Transmission Project, Brookhaven National Laboratory, Upton, New York 11973). Appl. Phys. Lett. 25: No. 12, 756-758 (15 Dec 1974).

ac losses and self–field critical currents were measured in a Nb_3Sn tape between 4.2 and 17 K. The observed dependence of losses on current at 4.2 K is adequately reproduced by assuming a surface barrier $\Delta H = 710$ Oe and a bulk critical current density $J_c = 5.7 \times 10^6$ A/cm^2. The temperature dependence of losses above 4.2 K can also be reproduced by taking into account the observed parabolic dependence of J_c on temperature and by postulating a $[1-(T/T_c)^4]$ dependence for ΔH. A new technique is described for measuring the critical current. (auth)

9191 RELATIONSHIP BETWEEN T_c AND N(0): An NMR STUDY OF $V_3Ga_{1-x}Si_x$. Fradin, F.Y.; Williamson, J.D. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. B 10: No. 7, 2803-2811 (1 Oct 1974).

From the measured normal–state values of the ^{51}V spin–lattice relaxation rate and nuclear–electric–quadrupole interaction in $V_3Ga_{1-x}Si_x$, we have determined the bare electronic density of states at the Fermi level, N(0), using a tight–binding formalism. In the high–T_c compositions, N(0) is dominated by the π–symmetry d subband that can be thought of as a narrow virtually localized state on the vanadium atoms (half–width $\simeq$ 20 mRy) which is broadened by compositional fluctuations. It is found that the superconducting transition temperature normalized by the Debye temperature (T_c/Θ_D) for the $V_3Ga_{1-x}Si_x$ and $V_3Ga_{1-x}Sn_x$ compounds is a universal function of N(0). The relationship between the mass renormalization λ and N(0) is considered in terms of the renormalization of the phonon frequencies due to electronic screening. (auth)

9192 FAR–INFRARED MEASUREMENTS OF THE PHONON DENSITY OF STATES OF SUPERCONDUCTING LEAD. Farnworth, B.; Timusk, T. (Department of Physics, McMaster University, Hamilton, Ontario, Canada). Phys. Rev. B 10: No. 7, 2799-2802 (1 Oct 1974).

Far–infrared measurements of the derivative of the reflectivity of lead and lead alloys in the superconducting state are presented. The derivative of the reflectivity contains detailed information about the phonon spectrum including peaks not observed by tunneling spectroscopy. The peaks are, in general, in good agreement with neutron measurements and include evidence of phonon lifetime effects at a phonon frequency of 2Δ. (auth)

9193 SOME FINITE–TEMPERATURE PROPERTIES OF SUPERCONDUCTING Bi_2Tl. Vashishta, P. (Argonne National Laboratory, Argonne, Illinois 60439); Carbotte, J.P. Phys. Rev. B 10: No. 7, 2789-2791 (1 Oct 1974).

We present results of numerical calculations of the thermodynamic properties of Bi_2Tl based on solutions of the Eliashberg equations at finite temperature. Realistic kernels derived from quasiparticle tunneling experiments are employed throughout. (auth)

9194 INFLUENCE OF HYDROGEN ON THE THERMAL CONDUCTIVITIES OF SUPERCONDUCTING Nb AND Ta. O'Hara, S.G.; Sellers, G.J.; Anderson, A.C. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. B 10: No. 7, 2777-2781 (1 Oct 1974).

The thermal conductivities of superconducting Nb and Ta have been measured in the temperature range 0.04–4 K with and without the presence of dissolved H or D. In Nb doped with D the phonon mean free path exhibits a minimum which occurs at the same temperature at which a deuterium—related anomaly has been observed in the specific heat. Phonon scattering caused by the addition of H to Nb or Ta is complicated by the presence of resonant scattering from dislocations produced by precipitation of the β—phase hydride. (auth)

9195 ANOMALOUS HEAT CAPACITIES OF NIOBIUM AND TANTALUM BELOW 1 K. Sellers, G.J.; Anderson, A.C. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801); Birnbaum, H.K. Phys. Rev. B 10: No. 7, 2771-2776 (1 Oct 1974).

The specific heat of superconducting Nb has been measured in the temperature range 0.06—2 K in an outgassed condition (initial H and D concentrations $\lesssim$ 1 ppm atomic) and with H or D added as interstitial solutes. The specific heat of superconducting and normal Ta has also been measured in the outgassed condition and with H intentionally added. The addition of H or D to these bcc transition metals produces an isotope—dependent specific—heat anomaly which appears to be related to a displacive motion of the interstitial H or D. No evidence is found in either metal which would be suggestive of a second superconducting energy gap. (auth).

9196 TEMPERATURE AND MAGNETIC FIELD DEPENDENCE OF THE SUPERCONDUCTING PENETRATION DEPTH IN PURE AND IMPURE ALUMINUM SINGLE CRYSTALS. Behroozi, F.; Garfunkel, M.P.; Rogan, F.H.; Wilkinson, G.A. (University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. B 10: No. 7, 2756-2763 (1 Oct 1974).

Measurements at about 0.9 MHz of the temperature dependence of the penetration depth in pure and impure single crystals of aluminum are found to be in substantial agreement with the calculations of Miller, while at the same time showing some anisotropy effects for the pure samples. The effect of a static magnetic field on the surface reactance at this frequency is found to be in substantial agreement for the pure samples with a model proposed by Garfunkel for extreme type—I superconductors. Near the superconducting transition temperature the effect of the static field is compared with the Ginzburg—Landau theory, with only limited success for the impure aluminum sample. (auth)

9197 HIGH—FIELD MAGNETIZATION OF DILUTE RARE EARTHS IN YTTRIUM. Touborg, P.; Høg, J. (Department of Electrophysics, Technical University, 2800 Lyngby, Denmark); Cock, G.J.; Roeland, L.W. Phys. Rev. B 10: No. 7, 2952-2954 (1 Oct 1974).

Magnetization measurements have been performed on single crystals of Y containing small amounts of Tb, Dy, or Er at 4.2 K in fields up to 295×10^5 A/m (370 kOe). Crystal—field and molecular—field parameters obtained from measurements of the initial susceptibility versus temperature give a satisfactory quantitative account of the high—field magnetization. This includes characteristic features due to the crossing and mixing of crystal—field levels. (auth)

9198 MAGNETIC PROPERTIES OF SUPERCONDUCTING In—Bi ALLOYS. Kirshner, I.; Bankuti, J.; Kiss, G.; Kovacs, I.; Laszlofy, L.; Remenyi, G.; Chiou, C. (Univ., Budapest). Zh. Eksp. Teor. Fiz.; 66: No. 6, 2141-2152(Jun 1974). (In Russian).

The superconducting properties of In—0.5 at. % Bi alloys with low Ginzburg—Landau parameters are investigated by various methods. The concentration dependence of the critical temperature, critical magnetic fields and Ginzburg—Landau parameter and also the temperature dependence of the critical fields are determined. A transition occurs at the critical concentration C_c = 1.55 at. % Bi, type I superconductivity transforming into type II. Characteristic data of the transition are obtained. The flux flow state of the alloys is also investigated. The experimental results for the flux flow resistances correspond to such curves as can be described by the temperature-dependent critical magnetic fields. Two linear parts and two parts with different curvature exist in the voltage-current diagram. As a consequence there exist two critical currents and two flux flow resistances. (auth)

9199 STRUCTURE AND PHASE COMPOSITION OF SINTERED DEFORMED ALLOYS. Lavpent'ev, I. A.; Barantseva, Z. V.; Shchegoleva, R. P. (Inst. of Project for Reheated Metals, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 95-99 (Oct 1974). (In Russian).

The structure and phase composition of sintered deformed alloy KhN55VMTFKYu (Ni—10-12.6 Cr—3.15 to 5 Mo—3.75-5.05 W—1.75-1.96 Ti—2.85-4.30 Al—12-14.1 Co) were investigated. γ-solid solution on the nickel-base, γ^1-phase of the Ni_3(Ti, Al) type, carbides and carbonitrides serve as structural components of the alloy. From the phase analysis, the formula of the hardening γ^1-phase is determined. Mechanical properties of the alloy at room temperature and at 900°C are presented. (auth)

9200 KINETICS OF THE RECRYSTALLIZATION OF FILAMENTARY MOLYBDENUM. Karpinos, D. M.; Kondrat'ev, Yu. V.; Rutkovskii, A. E.; Stashevskaya, I. A.; Shiyanovskaya, I. E. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 86-89(Oct 1974). (In Russian).

Duration of the isothermal annealing up to the beginning of recrystallization was determined as a function of temperature. Activation energy for the beginning of the recrystallization process of filamentary Mo is 140 kcal/g · atom. With increase of the annealing temperature and the time of holding at temperature, the quantity of diffraction fifths increased, splitting of the fifths into doublets was observed, and transverse darkening from the plate of the Soller slit appeared. This indicates the increase of the amount of recrystallized gains and improvement of its structure. This appears most clearly at the maximum annealing temperature of 1300°C. (tr-auth)

9201 THERMO-ELECTRIC E.M.F. AND HALL EFFECT IN NICKEL—CHROMIUM—MOLYBDENUM ALLOYS. Chetverkina, G. E.; Yaroshik, L. V. Tr. Nikolaev. Korablestroit. Inst.; No. 52, 90-96(1972). (In Russian).

The thermo-electric e.m.f. and the Hall effect were studied as a function of heat treatment and plastic deformation in creep-resistant Ni—Cr—Mo alloys containing Cr 20.5 and Mo 1.6, 3.31, 6.54, 12.77, and 15.76 wt.-%. The thermo-electric e.m.f. is inversely related to the Mo concentration in the worked and annealed alloy. (Referativnyi Zh.)

9202 STRUCTURAL NITRIDING STEELS. Gladova, G. V.; L'vovskii, A. Ya. (Moscow Highway Inst.). Metal Sci. Heat Treat. (USSR)(Engl. Transl.); 16: No. 3-4, 227-230(1974).

Translated from Metalloved. Term. Obrab. Metal.; 16: No. 3, 30-33(Mar 1974).

Alloying of steels with Ti and V permits the nitriding temperature to be raised 560-650°, for shorter nitriding times. 0.6 to 1% V is most effective in raising the nitriding rate and case hardness. The optimum Ti/c ratio is 6.5 to 9.5. The best nitriding temperature is 560° for Cr—Mo steel with 0.6 to 1% V and 600° for steels with Ti. Wear resistance, fatigue limit, etc. of the new steels are higher than those of commercial nitriding steels. Steels with V are recommended for engine parts; steels with Ti for machine parts under varying loads. (4 tables) (DLC)

9203 EFFECT OF VANADIUM ON THE FORMATION AND COMPOSITION OF THE BORIDE CASE ON IRON. Trush, I. Kh.; Permyakov, V. G.; Kirchev, B. S. (Kiev Polytechnical Inst.). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 3-4, 270-271(1974).

Translated from Metalloved. Term. Obrab. Metal.; 16: No. 3, 69-70(Mar 1974).

Addition of 0.10 to 0.15% V increases the case depth. The boride case consists of three phases (FeB, Fe_2B, and α solid solution); with increasing V content, the amount of FeB increases as does the microhardness of the borides. (auth)

9204 METASTABLE DIAGRAM OF HIGH-PURITY Ti—Mo ALLOYS. Guseva, L. N.; Egiz, I. V. (Inst. of Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 3-4, 355-356(1974).

Translated from Metalloved. Term. Obrab. Metal.; 16: No. 4, 71-72(Apr 1974).

The Ti-rich side was studied with samples 2 to 10 at. % Mo prepared by melting and quenching from 600 to 900°C. The existence ranges of metastable phases that occur during quenching from the β region are (with increasing Mo contents): α', $\alpha' + (((\beta)))$, $\alpha'' + ((\beta))$, $\alpha'' + \beta + \omega$, $\beta + \omega$, β, where α' and α'' are hexagonal and orthorhombic martensitic phases; β is solid solution based on bcc Ti; ω is a hexagonal metastable phase. Precipitation of ω phase occurs particularly for 5 at. % Mo. Hardness is shown as a function of Mo content and quenching temperature. (DLC)

9205 FINE STRUCTURE OF NITRIDED STEELS. Gavrilova, A. V.; Gerasimov, S. A.; Kosolapov, G. F.; Tyapkin, Yu. D. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 3-4, 210-216(1974).

Translated from Metalloved. Term. Obrab. Metal.; 16: No. 3, 14-20(Mar 1974).

Structures formed in the process of nitriding are similar to those observed in aging alloys (e.g., Cu—Be and Ni—Be) during decomposition of supersaturated solid solutions. The nitride phase precipitated in 4 at. % binary Fe—Al, Fe—Cr, and Fe—Mo alloys and steels 40Kh and 38KhMYuA have a B1 structure (NaCl type). The high strength of the nitrided case on steel 38KhMYuA is due to a considerable extent to distortion of the matrix (α phase) resulting from the formation of finely dispersed nitrides completely or partially coherent with the matrix. Maximum hardness is reached in the initial stage of nitride formation when the thin (single layer of nitrogen atoms) lamellar nuclei are completely coherent with the matrix. The high hardness of the nitride case is due mainly to Al. Addition of Cr and Mo to steel 38KhMYuA makes it possible to obtain (at a sufficiently high nitriding temperature) nitrides with a structure corresponding to the early stages of their formation, which favors a fairly large case depth and high hardness. (auth)

9206 NEUTRON DIFFRACTION BY VORTEX LATTICES IN SUPERCONDUCTING NIOBIUM. Lippmann, G.; Schelten, J. (Kernforschungsanlage, Juelich, Ger.). J. Appl. Crystallogr.; 7: No. 2, 236-239(1 Apr 1974).

From 3rd international conference on small-angle scattering; Grenoble, France (4 Sep 1973).

Neutron diffraction experiments on vortex single crystals reveal various information on properties of flux-line lattices. Data from a pure single-crystal Nb rod with its axis parallel to a ⟨111⟩ direction and a Ginzburg–Landau parameter of 0.9 are presented. For the largest achievable lattice parameter of 1940 Å at 4.2°K, a hexagonal flux-line lattice with an azimuthal mosaic spread of 60′ and a radial one of less than 1.2′ was found. From the integrated reflectivity, absolute form factors were found at the reciprocal lattice points 10, 11, 20, 21, 30, and 31, and the local magnetic field distribution was then calculated. (auth)

9207 EFFECT OF IMPURITIES AND PRESSURE ON THE SUPERCONDUCTING TRANSITION TEMPERATURE IN THALLIUM. Ignat'eva, T. A.; Makarov, V. I.; Cherevan, Yu. A. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 67: No. 3, 994-1005(Sep 1974). (In Russian).

The effect of impurities of various valency and pressure up to 12 katm on T_c in thallium in triple solid solutions (thallium with mercury or indium impurities) is investigated. By investigating triple solid solutions, one can experimentally separate and assess the contributions of two possible nonlinear mechanisms of action of the impurities on T_c. One of the mechanisms involves a decrease of electron-electron interaction anisotropy on scattering of electrons by the impurities and the other involves alterations in topology of the Fermi surface. (8 fig) (auth)

9208 THERMAL EXPANSION AND THE CRYSTAL STRUCTURE OF Pr, Nd, AND Sm IN THE 87 TO 1073 K RANGE. Smirnov, Yu. N.; Prokhorov, I. A. Zh. Eksp. Teor. Fiz.; 67: No. 3, 1017-1022(Sep 1974). (In Russian).

The temperature dependence of the lattice constants and electric resistances of Pr, Nd, and Sm are determined. Anomalies are observed for Pr at 605–608°K, for Nd at 648–750°K, and Sm in the 380–500°K range. The discontinuities in the atomic volume and electric resistance of Sm near 980°K are due to phase transitions of the first kind rhombohedral ⇌ hcp. (auth)

9209 MICROSTRUCTURAL PECULIARITIES IN Cr12NiWMoVTi (T60) STEEL AFTER ELECTROSLAG REMELTING. Koutsky, J.; Barackova, L.; Jezek, J.; Stransky, K. Kovove Mater.; 11: No. 4, 434-437(1973). (In Czech).

A forging from T 60 steel was electroslag remelted (ANF 6 slag was used) into a water-cooled mold. It contained, after remelting, 0.27% C, 0.58% Mn, 0.48% Si, 0.026% P, 0.018% S, 11.50% Cr, 1.69% Ni, 0.21% V, 0.50% Mo, 0.93% W, 0.14% Ti, 0.18% Cu, 0.007% Al, 0.017% N. The ingot was annealed at 780°C/6h, cooled to 720°C in an oven, then in air and tested by ultrasound (defects were found in the central region). Microstructure was studied by electron microscopy and microanalyses were carried out for the central region. Light spots and heterogeneous particles were found and the former were identified as ferrite and the coarse globular and prismatic particles as $M_{23}C_6$ carbide. Ferritic spots contain more Cr, W, and Mo. Formation of this structure is discussed. (Metals Abstr.)

9210 OVERLOAD INDUCED DELAYS IN FATIGUE CRACK GROWTH IN Ti–6Al–4V TITANIUM ALLOY. Dubensky, R. (Ford Motor Co., Dearborn, MI). pp 195-201 of Mechanical Behavior of Materials. Kyoto; Society of Materials Science(1974).

From conference on mechanical behavior of materials; Kyoto, Japan (21 Aug 1973).

Fatigue crack growth tests were conducted on center-cracked sheet specimens made of Ti–6Al–4V titanium alloy. Single and multiple tensile overloads were systematically applied to these specimens. Both the number and magnitude of the overloads were increased to investigate their effects on subsequent fatigue crack growth at lower loads. Quantitative values of the fatigue crack growth delays (or retardations in the rate of fatigue crack growth) are reported for various stress levels. All single tensile overloads delay subsequent fatigue crack growth at lower levels. Overload induced delays were greater for larger values of the overload at a given subsequent low level. The magnitude of the fatigue crack growth delay increased with increasing numbers of high load cycles (up to a limiting value). (auth)

9211 EFFECT OF SILICON CONTENT ON THE LONG TIME (CREEP-RUPTURE) BEHAVIOR AND EMBRITTLEMENT OF HIGH TEMPERATURE X10 CoCrWNi 50 20-TYPE COBALT ALLOY. Kreitner, F. Berg- Huettenmaenn. Monatsh.; 117: No. 11, 419-427(Nov 1972). (In German).

Co-based multiphase alloys for high temperature applications, e.g. in gas turbines, must exhibit good creep strength, good thermal and mechanical fatigue strength, and exceptional resistance to high-temperature oxidation and corrosion. Compositions of a number of forged and cast Co-alloys are presented and particular attention is paid to the X10 CoCrWNi 50 20 grade. Effects of the Si content, of this alloy (0.14-0.72% Si) on the notch-impact toughness and creep-rupture properties within the 700-950°C range are shown. 19 ref. (Metals Abstr.)

9212 DEFORMATION MECHANISMS IN ZIRCALOY-2 AT LOW TEMPERATURES. Samuel, K. G.; Rodriguez, P. Trans. Indian Inst. Metals; 26: No. 4, 14-19(Aug 1973).

Below 300°K, deformation is controlled by a single mechanism acting alone: the interaction of dislocations with interstitial solutes. Above 300°K, the situation is much more complex, and no single mechanism is rate controlling. Possible mechanisms are suggested and discussed. (Metals Abstr.)

9213 CONTRIBUTION TO THE Sm–Co PHASE DIAGRAM. Khan, Y. (Univ., Bouchum, Ger.). Acta Crystallogr., Sect. B; 30: No. 4, 861-864(15 Apr 1974).

The Co-rich part of the Sm–Co system was investigated by x-ray diffraction, metallographic, and thermoanalytic methods. The existence of five closely related compounds (Sm_2Co_7, $SmCo_{5-x}$, $SmCo_5$, $SmCo_{5+x}$ and Sm_2Co_{17}) was confirmed. A tentative phase diagram of the Co-rich part of the Sm–Co system is presented. Difficulties encountered in the construction of this phase diagram are discussed. (auth)

9214 NICKEL-PLATED URANIUM: BOND STRENGTH. Dini, J. W.; Johnson, H. R.; Helms, J. R. Plating; 61: No. 1, 53-56(Jan 1974).

The effect of temperature on the bond strength between Ni plating and U was determined by conducting ring shear tests. Data show that properly etched and plated U can withstand a fair amount of high-temperature heating without undergoing a complete loss of the bond between the plating and the substrate. (Metals Abstr.)

9215 PYROMAGNETIC RESPONSE OF TYPE I SUPERCONDUCTORS. Yeargain, J. R. Austin, TX; Univ. of Texas (1974). 70p. University Microfilms Order No. 74-24,955.

Thesis (Ph.D.).

The magnetic response due to optically induced heating of the intermediate state of Sn, In, Pb, and Sn–In alloys was examined. Foils of the superconductor are periodically heated by a modulated light source and the resulting changes in the sample's magnetic moment are monitored via the voltage induced in surrounding pickup coils. The response as a function of magnetic field, angle of the field, temperature, and modulation frequency (10 Hz to 100 KHz) was measured and compared to quasi-static and dissipative models. For low frequencies, the response of Sn, In, and their type I alloys is found to be in good agreement with the quasi-static theory, indicating that the bulk behavior of these samples is highly reversible. The maximum response of these materials is found to be limited by the ratio of the critical field to the latent heat. At higher frequencies, the response is damped by eddy currents induced in the normal regions. The effect of the eddy currents on the response is calculated in terms of a structure-dependent model consisting of unbranched Landau domains. The model is found to closely approximate the observed field and frequency dependence of the response over a wide range of experimental conditions. The largest discrepancies are found to occur for large normal fractions of the state and for near parallel fields. These deviations are traceable to a breakdown of the Landau theory for the domain periodicity. For temperatures below 5°K, the response of lead samples becomes nonlinear and deviates substantially from quasi-static predictions. Experimental evidence indicates that in this region flux motion is dominated by the existence of a stable surface sheath. It is possible to observe the structure of the intermediate state by focusing the modulated light to a spot smaller than the basic periodicity; results indicate that resolution comparable to currently used magneto-optic methods is obtainable. (DLC)

9216 STUDY OF GERMANIUM FILMS ON TUNGSTEN BY THE AUTOELECTRON EMISSION METHOD. D'yakonova, N. I.; Mileshkina, N. V.; Chesnokov, A. D. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 2, 330-333(Feb 1974). (In Russian).

For English translation see the journal Bull. Acad. Sci. USSR, Phys. Sci.

Experimental data obtained during study of the self-emission characteristics of the Ge–W system were discussed. The density of the self-emission current and the energy distributions were calculated by the method of damped electron waves. (tr-auth)

9217 ON THE ELECTRON ENERGY DISTRIBUTION DURING AUTOEMISSION FROM TANTALUM, MOLYBDENUM AND TUNGSTEN CARBIDE COATED BY SILICON AND ALUMINIUM OXIDES. Bobev, K. S. (Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria). Tsentralna Lab. po Agrifozicheski Izsledvaniya). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 2, 338-344(Feb 1974). (In Russian).

For English translation see the journal Bull. Acad. Sci. USSR, Phys. Sci.

It was shown that with a degree of coating of the backing with oxides of $\Theta < 7$ the principal part of the emitted electrons tunnel from the metal and their energies are decreased with increase of Θ in the interval from 1 to 8 monolayers. With complete coating the tunneling is accompanied by the effect of electron-phonon and electron–electron interactions. (tr-auth)

9218 THE EFFECT OF ELECTRON-BEAM WELDING THERMAL CYCLING ON THE WELD FORMATION AND PROPERTIES OF WELDED JOINTS OF NIOBIUM WITH STEEL (VN-2aEh + Kh18N10T). Sivov, E. N.; D'yachenko, V. V. (Moskovskij Aviatsionnyj Tekhnologicheskij Inst. (USSR)). Svar. Proizv.; No. 4, 11-13(Apr 1973). (In Russian).

For English translation see the journal Weld. Prod.

It was established that the thermal cycling of welds has a decisive effect on the structure and properties of weld compounds of thin lamellar construction. During reheating or holding the metal at high temperature for a long period, intermetallic interstratification was observed which sharply decreases the strength of the compound. (tr-auth)

9219 MECHANICAL PROPERTIES OF MULTICOMPONENT ALLOYS ON THE BASE OF TITANIUM-ALUMINIUM-TIN (ZIRCONIUM) α-SOLID SOLUTION WITH β-STABILIZING ELEMENTS. Mikheev, V. S. Probl. Prochnosti; No. 10, 89-92(Oct 1973). (In Russian).

For English translation see the journal Strength Mater.

The mechanical properties of multicomponent Ti alloys with different concentrations of alloying elements, including β stabilizers, (in sum, varying from 11 to 29%) were studied at room and higher temperatures up to 900°C. The regularities in the alteration of the mechanical properties of the alloys as a function of the composition and the test temperatures were established; the optimum composition of these multicomponent Ti alloys, which lie in the region of concentration of alloying elements of 11 to 13%, are highly stable, ductile, and commercially practical. It was shown that the largest effect on the mechanical properties is caused by the thermal processing. (tr-auth)

9220 VELOCITY DISTRIBUTION OF THE THERMOELECTRONS, EMITTED BY SOME FACES OF THE TUNGSTEN WHISKER MONOCRYSTAL. Gorbatyj, N. A.; Chekina, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 2, 230-233(Feb 1974). (In Russian).

For English translation see the journal Bull. Acad. Sci. USSR, Phys. Sci.

The energy spectra of thermal electrons from tungsten were studied and this study led to conclusions on the energy dependence of the coefficient of reflection of thermal electrons on the potential barrier at the metal–vacuum boundary. The experimental results obtained did not give a single-value answer on the form of the distribution function of the thermal electrons with velocity. In the very precise study of the distribution function of thermal electrons according to velocity, homogeneous faces of whisker W monocrystals rotating around its axis were used as emitters. A cylindrical Yuz-Rozhan condenser was used as an analyzer. (tr-auth)

9221 A SIGMA-PHASE IN THE SYSTEM CHROMIUM-MOLYBDENUM-SILICON. Rudy, E. (Oregon Graduate Center, Beaverton (USA)); Nowotny, H. (Vienna Univ. (Austria). Inst. fuer Physikalische Chemie). Monatsh. Chem.; 105: No. 1, 156-168(Jan 1974). (In German).

A ternary σ-phase ($Cr_{0.39-0.57}Mo_{0.29}Si_{0.14}$) was detected in the chromium-molybdenum-silicon system at 1500°C. The novel σ-phase, which displays only a small degree of ordering, undergoes eutectoid decomposition at ca. 1200°C, into (Cr,Mo) + $(Cr,Mo)_3Si$. The relative stability of the ternary σ-phase and the non-existing binary σ-phases (Cr–Si, Mo–Si) were estimated from the observed equilibria. With respect to the coexistent phases there is an amount of 2500cal/g atom metal necessary for stabilizing of the ternary σ-phases at 1500°C. The slight deviation from completely random distribution reflects on the entropy change and there is fair agreement with the entropy change calculated from the temperature dependency of $\Delta G_{x,\sigma}$. (auth)

9222 ELECTRON EFFECTS IN THE THIN FILMS OF SOME TRANSITION METALS. Stasyuk, Z. V.; Bigun, M. M.; Mel'nichuk, B. L.; Panchishin, R. S. (L'vovskij Gosudarstvennyj Univ. (Ukrainian SSR)). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 2, 370-373(Feb 1974). (In Russian).

For English translation see the journal Bull. Acad. Sci. USSR, Phys. Sci.

The thermoelectric phenomena in films of Sc, Y, Ni, and Pd were studied. The experimental results were discussed within the framework of the model of two independent zones. (tr-auth)

9223 RELATION BETWEEN THE ENTHALPY PHYSICO-MECHANICAL AND EROSION CHARACTERISTICS OF METALS. Volchenkova, R. A. Elektron. Obrab. Mater.; No. 4, 58-62 (1973). (In Russian).

For English translation see the journal Appl. Electr. Phenom.

The relation between the enthalpy and the physico-mechanical and erosion characteristics of metals was shown. A series of metals from Hg to W, arranged in order of the increase of the binding energy between the atoms in the crystalline lattices and independent of the type of chemical bounds and crystalline state of the material, was given. It was established that the erosion characteristics of the metals and the electrical resistance of the interelectron spacing was determined by the binding energy between atoms. (tr-auth)

9224 ON THE INFLUENCE OF STRESS CONCENTRATION ON THE MECHANICAL PROPERTIES OF MOLYBDENUM PIECES WITH PROTECTIVE COATINGS TESTED IN OXIDATION MEDIUM. Zelenyuk, E. E.; Shkolyar, V. S.; Sosnovskij, L. A.; Ehpik, A. P. (AN Ukrainskoj SSR, Kiev. Inst. Problem Prochnosti). Probl. Prochnosti; No. 9, 56-59(Sep 1973). (In Russian).

For English translation see the journal Strength Mater.

The results of tests on flat Mo samples (smooth and with stress concentration) on the creep and short-term and prolonged strength at temperatures up to 1500°C in air are reported. The analysis of the experimental data is made in conjunction with the results of previous tests made on analogous samples in a vacuum. (tr-auth)

9225 ON CHARGE CONSERVATION BY AN ION ELASTIC SCATTERING FROM THE SURFACES OF METALS. Khashimov, N. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 2, 325-329(Feb 1974). (In Russian).

For English translation see the journal Bull. Acad. Sci. USSR, Phys. Sci.

The results of the measurement of the coefficient of scattering of Cl^- and Br^- ions from the clean surface of Pt, W, Ta, and Mo and of K^+ and Rb^+ ions from Pt and Mo surfaces respectively were reported and discussed. (tr-auth)

9226 ON THE LEVEL OF VM-1A MOLYBDENUM ALLOY EQUICOHESIVE TEMPERATURE AT SHORT-TERM TESTING IN VACUUM. Konoplenko, V. P.; Artyukhina, L. L.; Ovsepyan, E. S.; Vinogradova, V. S. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). Probl. Prochnosti; No. 10, 51-55(Oct 1973). (In Russian).

For English translation see the journal Strength Mater.

It was established that the equicohesive temperature of the alloy VM-1A in a vacuum of 5×10^{-4} and 5×10^{-5} mm Hg is roughly equal to 1250° and is increased both as a result of a triple flushing of the chamber with Ar (roughly 1450°) or after coating of the surface of the microsamples with heat-resistant coatings (above 1500°C). The level of the equicohesive temperature of the alloy is caused by the rate of development of surface microfissures, occurring at the site of the precipitation of the solid and brittle oxygen-containing phase on the surface boundary of the grain, which is enriched with the residual oxygen in the process of high-temperature testing. (tr-auth)

9227 HOW THE SILICON CONTENT AFFECTS THE LONG-TIME BEHAVIOUR AND THE EMBRITTLEMENT OF THE HIGH-TEMPERATURE ALLOY X 10 CoCrWNi5020. Kreitner, F. (Gebrueder Boehler und Co. A. G., Kapfenberg (Austria). Forschungsanstalten). Berg- Huettenmaenn. Monatsh.; 117: No. 11, 419-427(Nov 1972). (In German).

Also available as Boehler Forschungsbericht 470 from Fa. Gebr. Boehler u. Co, AG, A-8605 Kapfenberg, Austria.

The effect produced by the different alloying elements with respect to rupture strength, toughness, oxidation stability and workability; properties of the alloy X 10 CoCrWNi 50 20 and the effects of higher or lower Si content on the precipitation behavior within the temperature range from 750 to 950 degrees centigrade; and the effect on rupture strength, toughness and structure during long-time stress at increased temperature were studied. (auth)

9228 INVESTIGATION OF THE NICKEL MICROADDITIONS EFFECT ON THE MECHANICAL PROPERTIES OF MOLYBDENUM AND ITS ALLOY WITH CARBON. Malashenko, I. S.; Statkevich, V. N.; Shchukin, A. A. (AN Ukrainskoj SSR, Kiev. Inst. Ehlektrosvarki). Probl. Prochnosti; No. 9, 51-55(Sep 1973). (In Russian).

For English translation see the journal Strength Mater.

The effect of microadditions of Ni and C on the changes in the mechanical properties of polycrystalline Mo was studied as a function of temperature. It was shown that Mo alloys with 0.01 to 0.06 wt % Ni tend to a clearly dynamic aging in the temperature interval from 700 to 800°C. This is connected with the increase of C concentration in the solid solutions of Mo. High-temperature annealing at 400°C causes breakdown of the solid solution of C in Mo alloyed with Ni. (tr-auth)

9229 INTERPRETATION OF THE SPECTRUM OF Dy I. Study of Odd Configurations. Wyart, J. F. (Centre National de la Recherche Scientifique, 91 - Orsay (France). Lab. Aime Cotton). Physica; 75: No. 2, 371-385(1974). (In French).

The analysis of the spectrum of neutral dysprosium (Dy 1) was extended by use of new experimental data. The main features of the system of transitions $4f^{10}6s7s \rightarrow 4f^{10}6s6p$ are given. The semi-empirical calculation of the three lowest configurations $4f^{9}5d6s^{2}$, $4f^{10}6s6p$ and $4f^{9}5d^{2}6s$ taken together has led to the theoretical interpretation of 155 energy levels between 7,565 and 30,840 cm^{-1}. (auth)

9230 EXPERIMENTAL EQUATION OF STATE FOR LIQUID AND SOLID SODIUM. Makarenko, I. N.; Nikolaenko, A. M.; Stishov, S. M. (AN SSSR, Moscow. Inst. Kristallografii). Phys. Lett., A; 49: No. 3, 257-258(9 Sep 1974).

Volume measurements of liquid and solid sodium were performed at pressures up to 22 kbar and temperatures between 368 and 493°K. The experimental data for liquid and solid phases of sodium are represented in the polynominal forms which are used to calculate the isothermal compressibility β_T. The temperature dependences of β_T for the two phases are shown to be defined only by the entropy part of free energy of sodium. (auth)

9231 CRYSTAL STRUCTURE OF $BaCd_{4.43}$. Bruzzone, G.; Fornasini, M. L. (Univ., Genoa). Acta Crystallogr., Sect. B; 30: No. 2, 317-319(15 Feb 1974).

$BaCd_{4.43}$ has a hexagonal sub-cell, space group P6/mmm, with lattice constants a = 10.740 (3), c = 10.200 (3) Å, Q_{obs} = 7.35 g cm^{-3}. The true unit cell appears to be hexagonal with doubled a and c axes. A reasonable solution was obtained for the sub-cell by the symbolic addition method using photographic data. The sub-cell contains 7 atoms of Ba and 31 of Cd, with one set of cadmium positions partially occupied. (auth)

9232 HYSTERESIS OF WETTING OF METALS BY SILICATE MELTS. Visotskis, K. K.; Appen, A. A. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 4, 763-765(Apr 1974).

Translated from Zh. Prikl. Khim.; 47: No. 4, 744-747(Apr 1974).

Wetting of Armco Fe, 1 Cr18Ni9Ti steel, Ti, Zr, Cr, and Mo by 16 $Na_2$0.20 MeO · 64 SiO_2 was studied at 960 to 1260°. It is concluded that: high viscosities prevent spreading and recession of silicate melts, leading to high hysteresis values. Hysteresis diminishes with rise of temperature and decrease of viscosity, owing to improvement of both spreading and recession. In some experiments recession changes to spreading on increase of temperature, as the result of intensified interaction between the phases. Chemical interaction is also one of the causes of hysteresis: it prevents the melts from receding but does not always favor spreading (melts containing CoO or NiO). (3 tables) (DLC)

9233 CRYSTAL FIELDS IN $Er_{0.02}Y_{0.98}$ STUDIED BY NEUTRON SCATTERING. Rathmann, O.; Als-Nielsen, J.; Bak, P. (Atomic Energy Commission Research Establishment Risø, 4000 Roskilde, Denmark); Høg, J.; Touborg, P. Phys. Rev. B 10: No. 9, 3983-3987 (1 Nov 1974).

The splitting of the $J = 15/2$ multiplet of Er in an hcp crystal field has been determined by inelastic neutron scattering from a single crystal of $Er_{0.02}Y_{0.98}$. Least-squares fits to the spectra gave crystal-field parameters $B_{20} = -0.34 \pm 0.04$, $B_{40} = (0.7 \pm 0.2) \times 10^{-3}$, $B_{60} = (0.21 \pm 0.02) \times 10^{-4}$, and $B_{66} = (-0.30 \pm 0.03) \times 10^{-3}$ in K, in good agreement with results from bulk magnetization data. A significant line broadening of 1.0 meV full width at half-maximum was clearly observed in the first excited state at 2.2 meV. (auth)

9234 NEW INSTABILITY IN SUPERCONDUCTORS UNDER EXTERNAL DYNAMIC PAIR BREAKING. Chang, J.; Scalapino, D.J. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. B 10: No. 9, 4047-4049 (1 Nov 1974).

For superconducting films exposed to uniform laser radiation, it is found that the uniform distribution of quasiparticles is unstable when the system is driven sufficiently far from equilibrium. For $T/T_c < 0.7$, this instability occurs at lower laser intensities than the first-order supernormal transition for the uniform system and can drive the system into an intermediate state (dissipative structure). (auth)

9235 DEPRESSION OF THE SUPERCONDUCTING TRANSITION TEMPERATURE CAUSED BY 3d MAGNETIC IMPURITIES. Ginsberg, D.M. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. B 10: No. 9, 4044-4046 (1 Nov 1974).

The observed depressions of the superconducting transition temperature caused by 3d magnetic impurities are compared with the maximum possible value given by theory. Several discrepancies are found, but they might be completely removed by including in the theory the effect of orbital degeneracy. (auth)

9236 EFFECT OF ARGON AND HYDROGEN COATING ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF GRANULAR ALUMINUM. Deutscher, G.; Pasternak, M. (Department of Physics and Astronomy, Tel Aviv University, Tel Aviv, Israel). Phys. Rev. B 10: No. 9, 4042-4043 (1 Nov 1974).

Superconducting transition temperatures of pure Al, Al-Ar, and $Al-H_2$ mixtures condensed on substrates at 4.2 °K are measured. A reduction in T_c is observed for the Al-Ar mixture with respect to pure Al (T_c = 3.46 °K), and a significant increase in T_c is measured for $Al-H_2$. These results are discussed following recent observation of (i) T_c depression in films with noble-gas overlayers, and (ii) the formation of $Pd-H_2$ mixture superconductors. (auth)

9237 COMMENT ON THE HYPERFINE CONSTANT OF RARE-EARTH IONS IN DILUTE ALLOYS: Th:Er. Rettori, C. (Physics Department, University of California, Los Angeles, California 90024); Davidov, D. Phys. Rev. B 10: No. 9, 4033-4035 (1 Nov 1974).

The hyperfine constant of Er^{167} in dilute Th:Er^{167} alloys is measured and discussed in view of recent Mössbauer measurements. (auth)

9238 EFFECT OF LATTICE TRANSFORMATION ON THE PRESSURE DEPENDENCE OF T_c OF V_3Si SINGLE CRYSTALS. Huang, S.; Chu, C.W. (Department of Physics, Cleveland State University, Cleveland, Ohio 44115). Phys. Rev. B 10: No. 9, 4030-4032 (1 Nov 1974).

The superconducting transition temperature T_c has been measured under hydrostatic pressure up to 18 kbar on both transforming and nontransforming V_3Si single crystals. dT_c/dp was found to be always positive, but about 30% smaller for the nontransforming samples. The results are compared with predictions based on previous elastic-modulus measurements under pressure. (auth)

9239 METALLURGICAL EFFECTS AT HIGH STRAIN RATES. Conference Held at Albuquerque, New Mexico, February 5-8, 1973. Rohde, R. W.; Butcher, B. M.; Holland, J. R.; Karnes, C. H. (eds.). Metallurgical Society of AIME Proceedings. New York; Plenum Publishing Corp. (1973). 710p. (CONF-730210-). $32.00.

From symposium on metallurgical effects at high strain rates; Albuquerque, New Mexico, USA (5 Feb 1973).

This interdisciplinary volume begins with a tutorial session of invited papers, followed by sessions on phase transformations, dislocation drag mechanisms, dislocation dynamics, fracture processes, deformation mechanics, and microstructural effects. 40 papers plus discussions are included. Separate abstracts were prepared for 6 papers. (DLC)

For abstracts of individual papers see: 9240-9245.

9240 WAVE PROPAGATION IN BERYLLIUM SINGLE CRYSTALS. Pope, L. E.; Stevens, A. L. (Sandia Labs., Albuquerque, NM). pp 349-366 of Metallurgical Effects At High Strain Rates. Rohde, R. W. (ed.). New York; Plenum Publishing Corp. (1973).

From symposium on metallurgical effects at high strain rates; Albuquerque, New Mexico, USA (5 Feb 1973). See CONF-730210-.

Transmitted wave profiles are presented for Be single crystals that were shock loaded along several crystallographic directions to activate the primary, secondary, or tertiary slip systems. A definite elastic precursor with a risetime of a few nanoseconds was exhibited by each shock-loaded single crystal, independent of orientation. For single crystals in which secondary and tertiary slip systems were activated, elastic precursor spikes followed by regions of stress relaxation were observed. Multiple plastic wave propagation was observed in a crystal shock loaded along an axis of nonsymmetry. The resolved dynamic shear strength on basal, prism, and pyramidal planes for conditions of uniaxial strain is calculated and compared to quasi-static values. The elastic responses of the single crystals are compared to the ill-defined elastic precursors observed in shock-loaded polycrystalline Be, and it is concluded that the elastic response of polycrystalline Be is a consequence of the grains in aggregate. Spallation of beryllium single crystals verifies that the dynamic fracture planes are the same as those observed quasi-statically; fracture occurs on basal, type II prism, and pyramidal planes. (auth)

9241 CONSTITUTIVE RELATION FOR DEFORMATION TWINNING IN BODY CENTERED CUBIC METALS. Armstrong, R. W. (Univ. of Maryland, College Park); Worthington, P. J. pp 401–414 of Metallurgical Effects At High Strain Rates. Rohde, R. W. (ed.). New York; Plenum Publishing Corp. (1973).

From symposium on metallurgical effects at high strain rates; Albuquerque, New Mexico, USA (5 Feb 1973). See CONF-730210-.

A constitutive relation is developed to describe the grain size, temperature, and strain rate dependence of the stress required for the essentially elastic twinning of bcc metals at low temperatures. The relation is derived from a description of the bulk material strain produced by twinning and, also, from specifying on the basis of a thermal activation analysis the number of twins and the twinning nucleation rate. Two natural consequences of this development for bcc metals are that twins must be nucleated by pre-twinning slip and that twinning and brittle fracture are predicted to occur under very similar circumstances. These are normal experimental observations. (38 references) (auth)

9242 OBSERVATIONS OF SPALLATION AND ATTENUATION EFFECTS IN ALUMINUM AND BERYLLIUM FROM FREE-SURFACE VELOCITY MEASUREMENTS. Speight, C. S.; Taylor, P. F.; Wallace, A. A. (Atomic Weapons Research Establishment, Foulness, UK). pp 429–442 of Metallurgical Effects At High Strain Rates. Rohde, R. W. (ed.). New York; Plenum Publishing Corp. (1973).

From symposium on metallurgical effects at high strain rates; Albuquerque, New Mexico, USA (5 Feb 1973). See CONF-730210-.

An attenuation model is proposed in which the momentum associated with the pressure pulse is conserved and the energy is reduced by material absorption according to an assumed linear dependence on the excess stress above a yield stress. Experimental results compare favorably with the model and the coefficient for the energy absorbed/unit volume/unit stress is obtained. A fracture model is proposed in which the fracture process occurs in two stages: an initial brittle phase followed by a ductile–brittle phase in which material deformation occurs. The initiation of the brittle phase is determined by the incipient fracture strength which is taken to be a material constant. A quantitative argument is presented that the expected spatial density of the initial brittle fracture is directly proportional to the release stress gradient in the primary wave. The ductile–brittle phase can be described by a single growth parameter which relates the fracture rate to the degree of incipient fracture, and the growth parameter is determined essentially by the degree of brittleness of the material. (8 fig) (auth)

9243 WAVE PROPAGATION AND SPALLATION IN TEXTURED BERYLLIUM. Stevens, A. L.; Pope, L. E. (Sandia Labs., Albuquerque, NM). pp 459–472 of Metallurgical Effects at High Strain Rates. Rohde, R. W. (ed.). New York; Plenum Publishing Corp. (1973).

From symposium on metallurgical effects at high strain rates; Albuquerque, New Mexico, USA (5 Feb 1973). See CONF-730210-.

Plate impact experiments were conducted on polycrystalline beryllium samples of four different textures to determine the effect of texturing on the wave propagation and spall strength of beryllium. The samples were fabricated from a single billet of hot-pressed beryllium powder and characterized by chemical composition and grain size; the degree of texturing was quantified by basal plane pole figure analyses. Results indicate that (1) although the nominal spall strength is not significantly altered by the texturing, the distribution and character of the spall damage does vary markedly with texture; and (2) the elastic precursor wave is severely ramped in the as-pressed material, but appears as a sharply-rising wave in the highly textured material. A model for unrelaxed thermal microstresses is advanced to explain the suppression of the elastic precursor wave in the as-pressed beryllium. (5 fig) (auth)

9244 INFLUENCE OF MICROSTRUCTURAL FEATURES ON DYNAMIC FRACTURE. Shockey, D. A.; Seaman, L.; Curran, D. R. (Stanford Research Inst., Menlo Park, CA). pp 473–499 of Metallurgical Effects At High Strain Rates. Rohde, R. W. (ed.). New York; Plenum Publishing Corp. (1973).

From symposium on metallurgical effects at high strain rates; Albuquerque, New Mexico, USA (5 Feb 1973). See CONF-730210-.

Knowledge of the microstructural effects on dynamic fracture is summarized and an approach outlined for assessing the influence of microstructural variations. The dynamic fracture process involves the nucleation, growth, and coalescence of microfractures to produce spall or fragmentation. Observations of how the microfracture nucleation and growth are influenced by grain boundaries, precipitates, voids, defects, texture, and impurities are reviewed, and the possible control of dynamic fracture through microstructural control is discussed. A computational model of dynamic fracture is described. Materials reviewed include Be, 6061-T6 Al, polymers, and quartz phenolic. (12 fig) (DLC)

9245 WORK SOFTENING OF Ti–6Al–4V DUE TO ADIABATIC HEATING. Sulijoadikusumo, A. U.; Dillon, O. W. Jr. (Univ. of Kentucky, Lexington). pp 501-518 of Metallurgical Effects At High Strain Rates. Rohde, R. W. (ed.). New York; Plenum Publishing Corp. (1973).

From symposium on metallurgical effects at high strain rates; Albuquerque, New Mexico, USA (5 Feb 1973). See CONF-730210-.

At high strain rates at high temperatures (1300–1900° F), and for large deformations, Ti alloys exhibit considerable work softening. One of the work softening mechanisms, that due to the temperature rise caused by the plastic working, is studied in this paper. A constitutive equation is fitted to the data of Hoffmanner. A mathematical model for simple tension/compression is constructed, and calculated stress–strain curves are compared with the experimental results of Bühler. (8 fig) (DLC)

9246 SOLUTION SOFTENING IN NIOBIUM-BASE SUBSTITUTIONAL ALLOY SINGLE CRYSTALS. Vasudevan, A. K. Cleveland; Case Western Reserve Univ. (1974). 196p. University Microfilms Order No. 74-22,099.

Thesis (Ph. D.).

Alloy softening (AS) in many bcc materials is a problem relating to the origin of low temperature strength. In substitutional alloys of bcc structure, AS behavior has been attributed either to a decrease in the Peierls–Nabarro (PN) stress, to an increase in mobile dislocation density, or to the solute interactions that enhance dislocation motion. The present study was undertaken to determine which of the above models accounts for AS, and to characterize the AS behavior in substitutional alloy systems, using high-purity Nb as the base material. Adding controlled amounts of either O or Mo to the high-purity Nb resulted in alloy hardening behavior at 77 to 400°K. On the other hand, addition of both O and Mo produced AS in the O concentration range of 170 to 500 at. ppM below 300°K. This AS has been attributed to the interaction of two solute species having different hardening rates (HR), in a manner that reduces their normally additive strengthening contributions. Hence, AS can be interpreted as due to solute interactions that affect the number and distribution of thermally activated obstacles to dislocation motion. Comparison studies made on Nb–W–O and Nb–Re–Mo alloys showed that the mechanical properties of these alloys are similar to those of Nb–Mo–O alloys. Various models that attempt to describe the low temperature strength of bcc metals and athermal hardening theories are reviewed and found to be inadequate in quantitatively describing the strength of niobium-base alloys. (DLC)

9247 KINETICS OF STRESS RELAXATION IN NORMAL AND SUPERCONDUCTING STATES. Dotsenko, V. I.; Landau, A. I.; Pustovalov, V. V. (Physical-Technical Inst. of Low Temperatures, Kharkov). Phys. Status Solidi (b); 66: No. 1, 279-283(1 Nov 1974).

An investigation is described of the kinetics of stress relaxation and postrelaxational effects in normal (N) and superconducting (S) states of polycrystalline 99.9995% pure lead at 4.2°K. The work-hardening coefficient $\theta^{(r)}$ during stress relaxation was found to be much larger than that θ_{act} during dynamic deformation. It was also revealed that $\theta^{(r)}$ depends on the state of the sample (N or S state) where $\theta_N^{(r)} > \theta_S^{(r)}$. (auth)

9248 MICROSTRUCTURE AND KINETICS OF THE PLUTONIUM $\beta \rightarrow \alpha$ TRANSFORMATION AT SUBZERO TEMPERATURES. Allen, R. P.; Arrowsmith, H. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). J. Nucl. Mater.; 52: No. 2, 167-172(Oct 1974).

The relationship between β–Pu grain size and the grain size of the α–Pu formed by the $\beta \rightarrow \alpha$ transformation at subzero temperature (–60°C to – 100°C) was investigated using retained β prepared from high-purity, α-phase extruded Pu. Recently developed high-rate quenching techniques for Pu were used to retain coarse-grained β–Pu. The grain size of the α formed by the rapid $\beta \rightarrow \alpha$ transformation of coarse-grained β was substantially larger than the grain size of the α produced at the same subzero temperature by the comparatively sluggish transformation of fine-grained β. Conversely, the α formed from fine-grained β at a high α-phase transformation temperature (+78°C) had coarse grains. These microstructural observations represent the first direct evidence of a correlation between β and α grain size for the $\beta \rightarrow \alpha$ transformation at subzero temperatures. They also support previous observations of an apparent correlation between β grain size and $\beta \rightarrow \alpha$ transformation rates. These results further demonstrate that the subzero temperature grain-size relationship does not extend to high α-phase transformation temperatures. An activation energy of 10 kcal/mole was derived from the kinetic data for the $\beta \rightarrow \alpha$ transformation of retained, fine-grained β at temperatures below −80°C. (auth)

9249 CORRELATION OF THE WETTING BEHAVIOUR OF SODIUM ON NIMONIC PE16 WITH THE SURFACE O/Cr RATIO DETERMINED BY AUGER SPECTROSCOPY. Hodkin, E. N.; Mortimer, D. A.; Nicholas, M. G.; Riviere, J. C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). J. Nucl. Mater.; 52: No. 2, 131-141(Oct 1974).

The contact angle of liquid sodium on Nimonic PE16 was measured by the sessile drop technique, as a function of temperature of the substrate. Prior surface treatments given to the PE16 included mechanical polishing, chemical polishing, and oxidation at 700°C; the effect of subsequent argon-ion bombardment was also studied. Surface analyses by Auger spectroscopy were performed on duplicate specimens after each of the above treatments, and again after ion bombardment. Although on any of the surfaces at any stage there were between six and nine elements present, the only obvious correlation was that between the low-temperature (160°C) contact angle and the oxygen/chromium atomic ratio at the surface. Up to about 260°C the sodium was apparently inert and non-wetting but beyond that temperature the contact angle dropped rapidly until at about 500°C irreversible wetting occurred. At the same time the correlation with the oxygen-chromium surface atomic ratio disappeared. (auth)

9250 THE SOLUBILITY OF CARBON IN SODIUM. Ainsley, R.; Hartlib, L. P.; Holroyd, P. M.; Long, G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). J. Nucl. Mater.; 52: No. 2, 255-276(Oct 1974).

The solubility of carbon in sodium was determined over the temperature range 490 to 832°C and can be expressed by the relation $\log_{10}S(\text{wt ppM}) = 7.646-5970/T(K)$. The carbon is present probably as the dicarbide ion, except if oxygen or nitrogen is added, when the amount of dissolved carbon is enhanced by the formation of carbonate and cyanide respectively. When the sodium is cooled below freezing, the dissolved carbon readily plates out or absorbs on to surfaces in a way which is not easily reversed. (auth)

9251 DELAYED HYDROGEN EMBRITTLEMENT IN Zr−2.5 WT % Nb. Simpson, C. J.; Ells, C. E. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). J. Nucl. Mater.; 52: No. 2, 289-295(Oct 1974).

Delayed failures at welds in components of Zr−2.5 wt.% Nb are attributed to zirconium hydride forming at the root of a notch adjacent to the welds. Residual tensile stresses provide the driving force for growth of the hydride. The observed rate of growth is considerably higher than the rate calculated by techniques which give good quantitative agreement with experiments at about 575°K. Failures of the type studied here are inhibited by stress relief of the component in question. (auth)

9252 PHASE DIAGRAM OF HAFNIUM−COPPER ALLOYS RICH IN HAFNIUM. Pieraggi, B.; Dabosi, F. (Ecole Nationale Superieure de Chimie, 31 – Toulouse (France)); Armand, M. (Societe Ugine-Aciers, Ugine, France). J. Nucl. Mater.; 52: No. 2, 336-338(Oct 1974). (In French).

Experimental determination of the phase diagram for 11 alloys in the range from Hf to the compound Hf_2Cu is reported. (INSPEC)

9253 MOESSBAUER EFFECT ON YFe_3 COMPOUND. Morariu, M. (Institutul de Fizica Atomica, Bucharest). Solid State Commun.; 15: No. 8, 1313-1315(15 Oct 1974).

The thermal variation of the Mössbauer parameters of the YFe_3 compound between 78 K and T_c is studied. The results agree well with the magnetic measurements. For the iron site 18 (h) the presence of an anisotropic interaction splits the Mössbauer spectrum into two six-lines patterns with the intensities in 2 : 1 ratio but above 400 K the intensities of the Mössbauer spectra of the sublattices are in 1 : 2 : 6 ratio in agreement with crystallographic data. (auth)

9254 CRYSTAL FIELD SPLITTING IN γ-CERIUM. Millhouse, A. H.; Furrer, A. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenligen, Switzerland). Solid State Commun.; 15: No. 8, 1303-1306(15 Oct 1974).

Results are reported on an inelastic neutron scattering experiment to determine the crystal field splitting and level scheme for the $^2F_{5/2}$ multiplet in γ-cerium. For the first time in a metallic cerium system the inelastic peak is well resolved and the splitting, Δ, can be accurately determined. As a next logical step in improving the point charge model the screened point charge model is considered. The results are found to be a Γ_7 ground state and Δ = 67 K. (auth)

9255 TRAPPING OF INERT GAS IONS BY CONSTANTLY RENEWED SURFACES. Arifov, U. A.; Radjabov, T. D.; Lifanova, L. F.; Iskanderova, Z. A. (Inst. of Electronics, Tashkent). Radiat. Eff.; 22: No. 4, 259-266(1974).

Results of theoretical and experimental studies of the processes of trapping of gas ions by constantly renewed metal films, i.e., the trapping of gas ions in the process of deposition are described. A model was examined for trapping gases during simultaneous ion bombardment and deposition. Theoretical calculations were undertaken for possible governing of curves derived from the concentration and amount of trapped impurities for three cases of assumed trapping probability functions under varying parameters of the process in time. Experimental studies were also made on the trapping of Ar ions with an energy of 1.5 to 2 keV and current density of $6.5 \times 10^{-6} + 6 \times 10^{-7}$ A/cm^2 by constantly renewed Sc film up to 3000 Å. The flash method was applied to measure the amount of trapped gas. Thermal desorption curves were derived, i.e., changes in the partial pressure of Ar within the measuring chamber during the heating of the target, depending on the temperature and period of heating, in the case of linear and step-by-step heating and also for various locations of the saturated layer. The activation energy of Ar in Sc film was estimated and found to be Q = 45 to 60 kcal/mol. (auth)

9256 CRITICAL BEHAVIOR OF THE SPECIFIC HEAT OF DYSPROSIUM NEAR THE NEEL TEMPERATURE. Lederman, F. L.; Salamon, M. B. (Univ. of Illinois, Urbana). Solid State Commun.; 15: No. 8, 1373-1376(15 Oct 1974).

The heat capacity has been measured in Dy near its Néel temperature. Careful analysis of the data shows an apparent change in the sign of the exponent α at t_d ~0.005. The outer region behaves universally with $\epsilon = 1$, $n = 2$ systems, having $\alpha = \alpha' = -0.02 \pm 0.01$, and the inner region has $\alpha = \alpha' = +0.18 \pm 0.08$, in agreement with predictions for anisotropic dipolar-dominated systems. (auth)

9257 EXCHANGE IN RARE EARTH METALS AND INTERMETALLIC COMPOUNDS. Ray, D. K. (Univ., Grenoble, France). Solid State Commun.; 15: No. 8, 1471-1474(15 Oct 1974).

Analytical expressions of the isotropic and the anisotropic exchange integrals in rare earth metals and intermetallic compounds are derived using the augmented-plane-wave (APW) formalism. Numerical results for DyZn indicate that the d electrons contribute predominantly to both isotropic and anisotropic exchange at most points on the Fermi surface. (auth)

9258 RADIALLY CRACKED, CYLINDRICAL FRACTURE TOUGHNESS SPECIMEN. Jones, A. T. (Sandia Labs., Albuquerque, NM). Eng. Fracture Mech.; 6: No. 3, 435-446(Oct 1974).

A new fracture toughness specimen in the shape of a hollow circular cylinder was characterized, allowing more economical and representative use of as-formed cylinders in toughness tests. Several configurations of a cylinder with radial cracks parallel to the axis of revolution are described with respect to crack mouth compliance and stress intensity factor. Specimen geometries useful for fracture toughness tests are analyzed in detail, based on results derived from finite-element codes. Results of experiments using 7075-T6 aluminium and uranium alloys of known toughness showed good agreement with the analytical results. (auth)

9259 RELIABILITY OF REACTOR COMPONENTS AND SYSTEMS SUBJECT TO FATIGUE AND CREEP. Freudenthal, A. M. (George Washington Univ., Washington, D. C. (USA)). Nucl. Eng. Des.; 28: No. 2, 196-217(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The operation of nuclear reactors at elevated temperatures involving pressure- and temperature-cycling as well as corrosion and irradiation is associated with the gradual deterioration of the mechanical resistance of their critical components. The rate of deterioration depends not only on the intensity of the loading conditions and the level of the operating variables, but is sensitive to their sequence and interaction. The lack of independence that is reflected by the development, under operating conditions, of creep and inelastic cyclic strain, as well as by the deterioration of the strength properties accompanying such deformation (creep rupture, fatigue), introduces additional potential failure modes or conditions, consideration of which, in the reliability analysis, shifts the emphasis of this analysis from the catastrophic limiting states of failure under remote extremal conditions, of recurrence periods that are large multiples of the design (service) life of the structural element or system, to states of significant structural failure that seriously affect the operability of the reactor but are repairable, as well as to conditions of relatively minor structural failure of reactor elements during operation that are critical because they might lead to escape of contaminating fission products. After basic consideration of the formulation of structural reliability analysis and risk assessment for major structural failures in nuclear reactor plant systems, a review of the problems of design for creep and fatigue—with interaction between creep and fatigue effects—under reactor operational conditions is given. (auth)

Radiation Effects

Refer also to abstracts 9060 and 10142.

9260 (CEA-N-1594, pp 8-21) DEFECTS AND RADIATION EFFECTS IN SOLIDS. Lagrange, R.; Casali, G.; Moser, P. 1972. (In French).

In semi-annual progress report No. 2.

Work during the second half of 1972 at Grenoble in the field of radiation effects in solids is reviewed briefly. Results concern the diffusion of oxygen in pure iron, niobium, and nickel irradiated by neutrons, and the change in internal friction of nickel irradiated by electrons. (FR)

9261 (JAERI-M-5595) TRIAL IRRADIATION IN JMTR. 3. Iron and Steel. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 137p. (In Japanese). NTIS (US Sales Only).

Results were: 1. The smaller the grain size of ferritic steel, the less becomes its irradiation sensitivity (neutron-irradiation embrittlement). 2. The irradiation sensitivity of SM50A stainless-steel cladding is smaller in rolling than in welding. 3. The irradiation sensitivity of austenitic A533B steel is not influenced by its grain size, contrary to literature. 4. In high-temperature neutron irradiation (460-500°C), the change in mechanical properties of stainless steels by irradiation is not appreciable until a dose of about 10^{20}n/cm^2. 5. Relaxation loss of PC steel wire tends to decrease with irradiation. (DLC)

9262 (LA-UR-74-1453) NEUTRON IRRADIATION OF Nb_3Sn AND NbTi MULTIFILAMENTARY COMPOSITES. Parkin, D. M.; Sweedler, A. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 5p. (CONF-740957-3). Dep. NTIS $4.00.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

NbTi and Nb_3Sn multifilamentary composites were irradiated with fast neutrons at 60 ± 5°C to fluences of 1.2×10^{20} n/cm^2 ($E > 1$ MeV). NbTi shows only a moderate reduction of I_c as a function of neutron fluence in an applied field of 40 kG. Reductions in I_c were observed for fluences greater than 3×10^{17} n/cm^2 and saturate at 18% for fluences greater than $3-4 \times 10^{19}$ n/cm^2. Nb_3Sn showed large neutron induced changes in T_c, I_c, and H_{c2}. Reductions in T_c were observed for fluences greater than 7×10^{17} n/cm^2. No measurable changes in I_c (40 kG) were observed below 10^{18} n/cm^2. Between 2 and 3×10^{18} n/cm^2, however, there is an apparent threshold where a very rapid reduction in I_c (40 kG) is initiated. At the threshold, the decrease in T_c is 13%. Between the threshold and 1.1×19^{19} n/cm^2, I_c (40 kG) was reduced to 4% of the unirradiated value. These changes are analyzed in terms of the radiation-induced defects. The impact of the response to irradiation of both materials on their applications in fusion reactor magnets is discussed. (auth)

9263 (SAND-74-351) CALCULATIONS OF ANODE WITNESS PLATE DAMAGE DUE TO PINCHED RELATIVISTIC ELECTRON BEAMS. Widner, M. M.; Thompson, S. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1974. Contract AT(29-1)-789. 28p. Dep. NTIS $4.50.

A theoretical study of the material response of anode witness plates to tightly pinched relativistic electron beams is presented. The highly nonlinear response requires computer simulation for which the two-dimensional hydrodynamic code CSQ is used. The witness plate response, consisting of crater and spall formation, is well described by the simulation model and is in good agreement with experiments done on the Hydra electron beam accelerator. Calculations suggest the crater size depends most strongly upon the total energy deposited and is not a sensitive measure of the beam diameter. (auth)

9264 INTERACTION OF THE LOW ENERGY ELECTRONS WITH ORDERED STRUCTURES. Ionov, V. V.; Bazhanova, N. P.; Korablev, V. V.; Morozov, Yu. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 2, 225-229(Feb 1974). (In Russian).

For English translation see the journal Bull. Acad. Sci. USSR, Phys. Sci.

Up to the present studies on the characteristics of the interaction of slow electrons with solids have not succeeded in explaining the non-monotonic dependence of the primary secondary emission characteristics in the region of low values of the energy of the incident electrons E_p. This relates to the dependence of the coefficient of elastic reflection R and the actual secondary electron emission δ on E_p and to the total dependence $\partial(E_p)$. The dependence of the coefficients ∂, R, and δ on the angle of incidence of the primary electron θ at $E_p < 100$ eV and the dependences $\partial(E_p)$ and $R(E_p)$ at different angles have been almost completely neglected. The results of experimental studies on these dependences and the study of the effect on them of fine films of foreign materials were reported. (tr-auth)

9265 THE SURFACE OXIDATION OF ION-BOMBARDED NiMn ALLOY. Krasevec, V.; Navinsek, B. (Ljubljana Univ. (Yugoslavia)). Surface Sci.; 45: No. 1, 39-44(Sep 1974).

Surface oxidation of thin foils of NiMn alloy has been studied by transmission electron microscopy and electron diffraction. The surface was ozidized during bombardment with 50 keV protons at a residual pressure of 5×10^{-6} Torr at room temperature. In the first stage of oxidation small islands of MnO were formed on the surface of NiMn alloy. The oxide islands are irregularly distributed on both surfaces of the foil and are coherent with the NiMn base. Subsequent heating of the bombarded specimens was accompanied by formation of tetragonal $MnO_{1.88}$ in an orientation where (110) $MnO_{1.88}||$(101) NiMn. Comparison has been made with "normal" oxidation caused by heating of the specimens in approximately the same atmosphere. (auth)

9266 STAGE III DISLOCATION PINNING IN SILVER RESULTING FROM GAMMA IRRADIATION. Van Konynenburg, R. A. Davis, CA; Univ. of California (1974). 124p. University Microfilms Order No. 74-21,638.

Thesis (Ph. D.).

A brief review of radiation damage, point defects, and dislocation effects is presented, and results from theory and previous experiments are discussed. Apparatus for continuously measuring changes in the elastic modulus and internal friction during gamma irradiation < 4°K to well above room temperature is described. A novel hollow-cylinder sample geometry permits use of a source strength of only 1 Ci. Survey experiments over a wide temperature range and isothermal irradiations above room temperature are discussed. Results are explained in terms of the Koehler—Granato—Luecke vibrating string dislocation model and the Thompson—Buck—Huntington—Barnes defect-dislocation interaction model. Consistent results are obtained under the assumptions of wide dislocation splitting and the presence of two dislocation components. Long-range migration appears to occur first in Stage I in silver. The activation energy for the observed Stage III annealing is about 0.48 eV. The responsible defect is most likely the single interstitial atom. Pipe diffusion is necessary to explain the results. The trapping efficiency of dislocations could not be determined because of the presence of more than one dislocation component. (DLC)

9267 THE CONTRIBUTION OF INTERSTITIALS TO THE DIFFUSION OF GOLD AND COPPER IN ALUMINUM UNDER IRRADIATION. Acker, D.; Beyeler, M.; Brebec, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Section de Recherches de Metallurgie Physique). J. Nucl. Mater.; 52: No. 2, 331-332(Oct 1974). (In French).

A theoretical calculation shows that the interstitial diffusion mechanism can only explain the experimental observations if non-colinear as well as colinear jumps are taken into account. (INSPEC)

9268 VOID SWELLING IN ION-BOMBARDED MOLYBDENUM. Brimhall, J. L.; Simonen, E. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). J. Nucl. Mater.; 52: No. 2, 323-325 (Oct 1974).

Evans has recently published results on ion bombardment of single crystal molybdenum showing very low swelling values at 900°C. In a recent paper, the present authors obtained greater swelling values in 7.5 MeV Ta ion bombarded, single crystal molybdenum for a similar temperature range. Due to experimental malfunctions, the actual temperature was not known precisely but estimated to be about 940°C (±40). Some of the experiments were rerun and the temperature range expanded to 800°C—1000°C, and these results are presented. The void parameters and swelling are compared with those reported by Evans. Some differences are still apparent and some possible reasons for the differences are discussed. (auth)

9269 IRRADIATION-INDUCED PRIMARY CREEP. Dollins, C. C.; Tucker, R. P. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). J. Nucl. Mater.; 52: No. 2, 277-288(Oct 1974).

A model for primary creep of clad materials in an irradiation environment is developed subject to the following assumptions:

Creep is due to the glide of edge dislocations which encounter irradiation-produced depleted zones, as barriers to their motion. The rate controlling step is the climb of the dislocations through the zones. Irradiation affects the creep rate in two opposing ways: (1) the vacancy-rich depleted zones serve as pinning sites for the dislocations slowing their glide, (2) the radiation-produced interstitials and vacancies cause faster dislocation climb than would be expected out-of-pile. During the early stages of irradiation before the damage has saturated, far more isolated interstitials are produced than isolated vacancies. Consequently, the flux of interstitials to dislocations is substantially greater than that of vacancies causing the dislocations to climb relatively fast. Contributing also to the rapid creep rate in the early stages is the reduced number of obstacles available to pin the dislocations. (auth)

9270 THE OXYGEN SNOEK DAMPING AND AN ABNORMAL PEAK OF NEUTRON-IRRADIATED VANADIUM. Eto, M.; Matsuo, Y.; Ishino, S.; Mishima, Y. (Tokyo Univ. (Japan). Faculty of Engineering). J. Nucl. Mater.; 52: No. 2, 309-316(Oct 1974).

Measurements of low-frequency internal friction and electron microscope observations were made on neutron-irradiated vanadium with various oxygen contents. Irradiation was carried out at about 60°C to a fast fluence of 2×10^{17} or 5×10^{19} n/cm^2 ($E \geq 1$ MeV). The oxygen Snoek damping was decreased by irradiation and post-irradiation annealing below 200 or 250°C, while it began to recover by annealing above this temperature. Complete recovery was attained by 30 min anneal at 450°C in the case of the lower fluence, whereas in the other case it was not observed after the same treatment. The results of electron microscope observations were consistent with those of internal friction measurements. The specimens irradiated to 5×10^{19} n/cm^2 showed an abnormal peak after annealing above 250°C near the nitrogen Snoek temperature. The height of this peak, P_{max}^{-1}, was expressed as $P_{max}^{-1} \propto \exp(2.72 \times 10^3/RT) Q_{max}^{-1}$, where Q_{max}^{-1} is the height of the oxygen Snoek damping after each annealing. The mechanism for radiation-anneal hardening and the abnormal peak were considered in the light of these experiments. (auth)

9271 LOW-TEMPERATURE FAST-NEUTRON RADIATION DAMAGE STUDIES IN SUPERCONDUCTING MATERIALS. Brown, B. S.; Blewitt, T. H.; Scott, T. L.; Klank, A. C. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 52: No. 2, 215-228(Oct 1974).

The residual resistivity increase rate, $d\rho_i/dt$, as a function of induced resistivity for fast-neutron irradiated Cu, Nb, Nb doped with oxygen, V, Ta, Pb, Cd, and NbTi was studied after 18 K fast neutron irradiation. $d\rho_i/dt$ as a function of irradiation-induced resistivity was approximately linear for all samples. Saturation values of the resistivity and defect concentrations were determined and are comparable with previous values for Cu and Nb. The isochronal recovery was studied up to 579°K. Large effects of oxygen on the annealing behavior are observed in niobium and vanadium and annealing peaks are identified with oxygen migration near 460°K. (auth)

9272 THE EFFECT OF NEUTRON IRRADIATION ON THE PRECIPITATE DISTRIBUTION IN ADJUSTED URANIUM. Hudson, B.; Jackson, J. P. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment); Codd, I. (Leeds Univ. (UK)). J. Nucl. Mater.; 52: No. 2, 229-240(Oct 1974).

Precipitates in α-uranium are thought to be very important in controlling the swelling that occurs in the reactor. Cross sections from the 30 mm diameter adjusted uranium fuel bars were cut and heat-treated to give a UAl_2 precipitate distribution peaking at about 30 nm diameter. Alternate sections were irradiated to 500 MWd/te at 673°K. Comparisons before and after irradiation show that a new precipitate population is formed during irradiation. Since new precipitates can form, mechanisms of swelling resistance based on the effects of aluminum in solution are no longer tenable. (auth)

9273 THEORETICAL ANALYSIS OF STRESS, STRAIN AND FRACTURE FOR FAST REACTOR FUEL CLADDING UNDER CONSTANT POWER AND POWER-CYCLING CONDITIONS: VISCO-ELASTIC MODEL OF NUCLEAR FUEL PIN BEHAVIOUR. Gittus, J. H. (UKAEA Reactor Group, Springfields). Nucl. Eng. Des.; 28: No. 2, 252-256(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

In the model adopted for analysis, the strength of the pellet is entirely dictated by that of an outer crust—the zone within which irradiation creep is dominant. The inner bound of the outer crust is the isotherm at which irradiation creep and thermal creep become equal. The crust is assumed free from open radial cracks and in it swelling due to fission-gas precipitation is negligible. Solid fission products are the only source of swelling. Irradiation creep entirely dominates the plastic deformation of the cladding: like the pellet, the cladding swells even at zero stress. The stress (S) in the cladding at a constant rating is calculated as a function of burnup and rises towards an asymptote. Square wave rating variations produce a new equilibrium in which S alternates between levels that depend on the fraction (f) of burnup accumulated at high rating. At constant rating, the equilibrium value of S ($= S_\infty$) is about 3.5 MPa (500 psi) and the effects of irradiation dominate the deformation-processes in both pellet and cladding. The equilibrium tensile creep rate of the cladding is about 1.25×10^{-3}/atom % burnup. The approach to S_∞ occurs exponentially, with a time constant (τ) of about 5 hr (during which a burnup of about 0.02 atom % occurs). (auth)

Other Materials

Refer also to abstracts 8251, 9163, 9171, 9250, 9956, 10257, 10269, 10282, and 10388.

9274 (AD-779314) PHOTOLUMINESCENCE FROM IRRADIATION-INDUCED DEFECTS IN SILICON. Noonan, J. R. (Illinois Univ., Urbana (USA). Coordinated Science Lab.). Apr 1974. Contract DAAB07-72-C-0259. 181p. (R-645; UILU-ENG-74-2209). NTIS $5.50.

New information on radiative defects in Si is provided by three sets of experiments which study the photoluminescence from Si irradiated with electrons at low temperature (100°K), Si subjected to ion implantations, and electron irradiations of Al and Ga-doped Si. (GRA)

9275 (ARL/Met.-93) EFFECT OF NEUTRON IRRADIATION ON THE STRUCTURE AND MECHANICAL PROPERTIES OF CARBON FIBRES. Wicks, B. J. (Aeronautical Research Labs., Melbourne (Australia)). Mar 1974. 23p. Dep. NTIS (US Sales Only) $4.25.

The effect of fast neutrons on the mechanical and microstructural properties of carbon fibers heat-treated to various stages of graphitization was investigated. Changes in selected crystallinity parameters were used to monitor the microstructural disorder induced in each fiber type by three different irradiation doses. Associated changes in fracture strength and Young's modulus are related to the dependence of dislocation mobility on short-range microstructural damage. (3 tables, 4 figures) (auth)

9276 (COO-2027-9) MOTION OF IONS IN SOLID HELIUM. Final Report, May 1, 1969– August 31, 1974. Dahm, A. J. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Physics). 1974. Contract AT(11-1)-2027. 12p. Dep. NTIS $4.00.

Ions are used to probe vacancies and surface adatom diffusion in solid He. Further experiments are designed to search for vacancy waves and other excitations, and to study dislocation strains and the electrostriction of the lattice near a charge. The structure of excess electrons and positronium atoms in solid He is identified as a void state. The upper limit on the number of Lyman α is reduced by an order of magnitude. The elusive ESR signal of the negative ion in liquid He has been detected and this simple two-level spin system has been probed. A theory of tunnelling from the bubble state in liquid He is developed and a search for electrons which have tunnelled is carried out. Charged droplets have been extracted from liquid He and nitrogen with the application of moderate electric fields. The nonlinear response of the Josephson plasma mode in a superconducting tunnel junction is studied both theoretically and experimentally. Predictions are made for the analogous mode in condensed phases of ^3He. (auth)

9277 (ORO-3802-17) PRESSURE VARIATION OF SINGLE CRYSTAL ELASTIC CONSTANTS. Final Report. (North Carolina Univ., Chapel Hill (USA)). 31 May 1974. Contract AT(40-1)-3802. 9p. Dep. NTIS $4.00.

The variation with pressure of the single crystal elastic constants was measured and the elastic constants themselves and their temperature variation were measured. Results show the derived properties of 16 alkali halides and three materials, LiI, LiH, and mixed crystals, that were given special attention are discussed. The repulsive stiffness of the Li, Na, K, and Rb halides plotted against nearest-neighbor distance is shown graphically. Research indicates that for these 16 alkali halides the pressure derivative of the isothermal bulk modulus is practically invariant at a common value of 5.6 for this dimensionless quantity. (MCW)

9278 NEUTRON IRRADIATION EFFECTS AND STRUCTURE OF NONCRYSTALLINE SiO_2. Bates, J.B. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Hendricks, R.W.; Shaffer, L.B. J. Chem. Phys. 61: No. 10, 4163-4176 (15 Nov 1974).

The nature of the defects produced in noncrystalline SiO_2 and α–quartz single crystals by fast neutron irradiation ($E > 0.18$ MeV) has been investigated by Raman and infrared spectroscopy, small–angle x–ray scattering, and electron microscopy. Measurements were made at 25°C on samples irradiated to integrated fluxes (exposures) from $\sim 1\times10^{18}$ to 2×10^{20} neutrons/cm^2 (n/cm^2). It was observed that at 2×10^{20} n/cm^2, the α–quartz sample had been transformed to an essentially noncrystalline material. However, at 9×10^{19} n/cm^2, remnant crystallites of the original α–quartz having a radius of gyration of 47 Å were found. The spectra of the noncrystalline phase of these materials are interpreted in terms of local modes at defect centers. Simple models are considered which account for the vibrational spectra and extrapolated x–ray scattering in the forward direction. The post–irradiation annealing behavior of the α–quartz samples has been followed to 1000°C. It was found that the structure of the noncrystalline phase gradually transformed to that of unirradiated SiO_2. In the α–quartz sample irradiated to 9×10^{19} n/cm^2, the remnant microcrystallites were found to anneal out by 1000°C. (auth)

9279 STUDY OF DEFECTS IN ELECTRON IRRADIATED SILICON. Natarajan, K. Waterloo, Ont.; Univ. of Waterloo (1974). vp. Univ. of Waterloo, Ont.

Thesis (Ph. D.).

2.2-MeV electrons were used to produce defects in N-type, float-zone silicon. It is shown that irradiation fluences to 2×10^{17} e/cm^2 does not produce tailing in the density of states. Narrow peaks were found in the photoconductivity spectrum at photon energies of 0.97 and 0.79 eV. The temperature variation of the energy position of the peaks was studied and found to be small compared to the band gap. These peaks are identified with local excitations of the divacancy and a neutral defect. These defects were found to be effective hole trapping centres and the thermally stimulated conductivity (TSC) due to the defects was studied. Energy levels of the divacancy and the neutral defect are established from the results of the TSC and photoconductivity studies. To establish a correspondence between the levels found by the two different methods, a defect–lattice interaction had to be assumed. The defect–lattice interaction energy is found to be ~ 50 MeV. Carrier concentrations from Hall measurements were analysed using Landsberg Statistics to calculate the electron distribution on the defect centres. The model used to fit the concentration data is consistent with the TSC and photoconductivity results. The divacancy concentration was consistent with the known production rate of divacancies. The concentration of the neutral defect is consistent with the known production rate of the K-centre. (DLC)

9280 NEUTRON AND X-RAY POWDER DIFFRACTION STUDIES OF THE STRUCTURE OF URANIUM HEXACHLORIDE. Taylor, J. C.; Wilson, P. W. (Australian Atomic Energy Commission Research Establishment, Southerland). Acta Crystallogr., Sect. B; 30: No. 6, 1481-1484(15 Jun 1974).

UCl_6 is hexagonal, with a = 10.95 (1), c = 6.016 Å, space group $P\overline{3}$ ml ($D_{3}^{3}d$), and Z = 3. The neutron data were refined by the least-squares profile-fitting technique to a value of $\{\Sigma_i w(I_0-I_c)^2\}^{1/2} /(\Sigma_i wI_0^2)^{1/2}$, where I is the intensity corrected for background at a point i along the scan, of 0.16. The single uranium variable positional parameter was more reliably obtained by a least-squares refinement of the integrated intensities on a Debye–Scherrer photograph, the final value of $\Sigma_i(\Sigma_j JF_0^2-\Sigma_j JF_c^2)/\Sigma_i \Sigma_j JF_0^2$ for the x-ray powder data being 0.22, where i is a line in the x-ray pattern and j an hkl component with multiplicity J. The structure proposed by Zachariasen (Acta Cryst. (1948). 1, 285-287) was confirmed. The octahedron around the uranium atom at (000) is nearly regular, and around the uranium atom at (⅓, ⅔, 0.518) slightly distorted. The U–C+ distances lie between 2.41 (4) Å and 2.51 (4) Å. (auth)

9281 EFFECTS OF ION BEAM POLISHING ON ALKALI HALIDE LASER WINDOW MATERIALS. Bruce, J. A.; Comer, J. J.; Collins, C. V. (Air Force Cambridge Research Labs., Bedford, MA). Mater. Res. Bull.; 9: No. 11, 1531-1542(Nov 1974).

Samples of single-crystal KCl, KCl-KBr, and polycrystalline pressure-induced recrystallized KCl were polished using an argon beam. The angle of incidence of the ion beam, the ion current, and the time of sample exposure were varied. After polishing, the surfaces were examined by x-ray topography, scanning electron microscopy, transmission electron microscopy, and Nomarski techniques, and the absorption coefficient of the materials was measured. Effects of ion polishing on surface quality and absorption characteristics are discussed. (auth)

9282 PROTON IRRADIATION EFFECT ON SILICON. Barto, M. P.; Vasil'ev, A. M. (Moskovskij Ehnergeticheskij Inst. (USSR)). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 2, 407-411(Feb 1974). (In Russian).

For English translation see the journal Bull. Acad. Sci. USSR, Phys. Sci.

The form of the spatial distribution of defects of Si crystals irradiated by protons was established. In experiments on the accumulation of carriers an explanation was given for the regularities in the behavior of the last term in the expression $W = 1/\tau_0 + 1/\tau_p = 1/\tau_0 + K_\tau \phi$, where W is the recombination probability, ϕ is the radiation current, τ_0 is the lifetime in non-irradiated material, and K is the damage coefficient characteristic for a given type of radiation and a given material, $K_\tau = KD$ (where D is the diffusion coefficient). (tr-auth)

9283 EFFECT OF IONIZING RADIATION ON POLYESTERURETHANE ELASTOMERS. Klimanova, R. S.; Seregina, V. I.; Serenkov, V. I. Plast. Massy; No. 9, 27-29(1973). (In Russian).

For English translation see the journal Sov. Plast.

The effect of ionizing radiation on the physico-mechanical properties of polyesterurethane elastomers of different chemical structure was studied. It was shown that polyesterurethane elastomers based on furylglycide esters had the best resistance to the effects of γ radiation. (tr-auth)

9284 VISCOELASTIC ANALYSIS OF IRRADIATED GRAPHITE WITH VARIABLE CREEP COEFFICIENT. Chang, S. J. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Eng. Des.; 30: No. 2, 286-292(1974).

A refined analysis is made of a previous study (Chang et al. (1970)) concerning a method of stress analysis for irradiated graphite which may be used for molten salt breeder reactor (MSBR) core design. The method includes the effect of a variable creep coefficient which is caused by the nonuniform temperature distribution. To facilitate a simple formulation, it is assumed that the temperature dependence of the elastic response of the material is approximated to be inversely proportional to the creep rate. It is shown that the problem reduces to the solution of several associated (fictitious) elastic problems which have a common elastic modulus inversely proportional to the creep rate of the irradiated graphite. Numerical examples in the previous paper were recalculated on the basis of the present theory. It shows, for large dose values, some small differences compared with the previous calculation. This method is expected to be more effective for higher dose values and more sensitive creep coefficients. (auth)

9285 EPR OF GAMMA-IRRADIATED QUARTZ GLASSES ALLOYED WITH IRON. Pavlushkin, N. M.; Sparkisov, P. D.; Orlov, V. V.; Orlova, L. A. Zh. Prikl. Spektrosk.; 20: No. 6, 1099-1101(Jun 1974). (In Russian).

Changes in the EPR spectra of gamma-irradiated quartz glasses alloyed with iron were studied as a function of dose and irradiation temperature. In non-irradiated samples, the lines g = 3.7 and 2.0 for the Fe^{3+} ion were found. Samples irradiated at 77°K showed no EPR spectra. Heating to 293°K resulted in the appearance of absorption lines for Fe^{3+} and three E′ centers, $g_\perp = 2.0015$, $g_{||} = 2.0026$; $g_\perp = 2.0006$, $g_{||} = 2.0026$; $g_\perp = 1.9998$, and $g_{||} = 2.0022$. A narrow line, g = 2.0020, was also observed. At doses greater than 36 M rd, there was observed a total envelope spectrum with $g_\perp^{eff} = 2.0023$ and $g_{||}^{eff} = 2.006$. With low radiation doses the reverse disappearance of the spectra of the directed electron paramagnetic centers with a decrease in temperature is explained by the temperature migration of electrons with the $Fe^{(3+)-}$ ion to E′ centers and the reverse. The presence in quartz glass of three E′ centers is related to the nonuniform structure of quartz glasses, including the structural grouping of both the quartz and the cristobaliti. (tr-auth)

9286 CONCENTRATION DEPENDENCE OF THE SUPERCONDUCTING TRANSITION TEMPERATURE IN PdH_x AND PdD_x. Schirber, J.E.; Northrup, C.J.M. Jr. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. B 10: No. 9, 3818-3820 (1 Nov 1974).

We have verified the existence of an inverse isotope effect between homogeneous bulk PdH_x and PdD_x. Maximum x values achieved by high–pressure charging were 0.99 and 0.97 for the hydride and deuteride, respectively. Our extrapolated values for the superconducting transition temperatures of PdH and PdD are 8 and 10, respectively. (auth)

9287 EFFECTS OF IONIZING RADIATION ON CLEAVAGE SURFACE ENERGY OF SrF_2. Kraatz, P. (Northrop Research and Tech. Center, Hawthorne, CA); Zoltai, T. J. Appl. Phys.; 45: No. 11, 5093-5095(Nov 1974).

Changes in the apparent specific surface energy of the ((111)) planes of SrF_2 at 298°K induced by ^{60}Co γ irradiation were determined by a modified Obreimov-Gilman cleavage technique. The apparent surface energy is found to increase approximately linearly with the logarithm of total exposure to ^{60}Co γ irradiation in the range from 9.6×10^5 to 4.3×10^7 R. This effect is consistent with the decreased dislocation mobility and size of the loops generated at the crack tip, the increased concentration of dislocation sources, and the lengthening of the easy-glide region of the stress-strain curve. (auth)

9288 EFFECT OF CRYSTALLINE ANISOTROPY ON THE MAGNETOSTATIC SPIN WAVE MODES IN FERROMAGNETIC PLATES. II. Results for Finite Plates. Schneider, B. (Philips Forschungslaboratorium, Hamburg). Phys. Status Solidi (b); 66: No. 1, 99-106(1 Nov 1974).

The magnetostatic spin wave mode transmission through anisotropic rectangular slabs of YIG was investigated experimentally and dispersion curves were derived. The experimental results are interpreted by an approximate application of the theory developed previously. The agreement between theoretical and experimental results is good. (auth)

9289 THERMALLY INDUCED STRUCTURAL MODIFICATIONS IN PYROLYTIC CARBONS AND THEIR RELATIONSHIP WITH THE DEPOSITION TEMPERATURE. Vesentini, L.; Pellegrini, G.; Saracco, G.; Zubani, I. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center). J. Nucl. Mater.; 52: No. 2, 157-166(Oct 1974).

The heat-treatment effect on the structure of a series of well-characterized pyrocarbon specimens prepared in a fluidized bed from CH_4 between 1200 and 2000°C has been analyzed by X-rays. The correlation of the amount of thermally induced structural modifications with the temperature of deposition shows that specimens deposited around and below 1400°C are much more sensitive to annealing than those obtained at higher temperatures. The annealability of a number of structural properties appears to be most pronounced in the specimens deposited around 1400°C. This range of deposition temperature coincides with the region at which the specimens have their lowest degree of crystallinity and the microstructure changes from laminar to isotropic. An interpretation of these results is based on thermodynamic data and on the analysis of the pyrolysis processes which may be responsible for the structural anomalies in the pyrocarbons obtained around 1400°C. (auth)

9290 COMPLEX THERMODYNAMIC SYSTEMS. Sychev, V. V. Studies in Soviet Science. New York; Plenum Publishing Corporation (1973). 251p. $29.50.

Translated from Russian by John S. Shier.

A thermodynamic treatment is provided for specific kinds of systems of importance in modern technology, including superconductors, magnets, piezoelectric materials, and insulators. The basic principles of thermodynamics of solids are explored, and the results are applied to current problems. An in-depth coverage is given to systems of expansion, and there is a unique treatment of liquids with and without gravitation. (SFL)

9291 AN ELLIPSOIDAL YIELD FUNCTION FOR DENSITY VARIABLE MATERIALS. Shrivastava, H. P.; Dubey, R. N. (Waterloo Univ., Ontario (Canada). Dept. of Mechanical Engineering). Nucl. Eng. Des.; 30: No. 3, 413-417(1974).

The plastic deformation of most porous materials causes plastic volume changes. The yield condition, therefore, depends upon the mean hydrostatic pressure in an essential manner. Since density of the material varies with the deformation it is assumed that the density variations determine the state of the material. An ellipsoidal yield condition was derived which takes into account the Bauschinger effect as well. The results were applied to graphite. (auth)

9292 LUMINESCENCE SPECTRA OF LANTHANUM AND EUROPIUM OXYFLUORIDES. Petrov, V. L.; Shul'gin, B. V.; Gavrilov, F. F.; Bamburov, V. G.; Vinogradova-Zhabrova, A. S. (Ural Polytechnic Inst., Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 4, 533-535(Apr 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 4, 624-627(Apr 1974).

Transitions in the region 400 to 650 nm were identified for these compounds. The solid solutions LaOF–EuOF exhibit an increase in the radiation intensity of Eu by more than one order of magnitude in comparison with pure EuOF, without any change in the appearance of the spectrum in the red region. When EuOF is incorporated into CaF_2, the transition $^5D_0-^7F_0$ is more intense than any other; Eu^{3+} is partly reduced to the divalent state, which is very stable. The point symmetry of the radiative centers is found to be C_{3V}. (auth)

9293 URANYL-CONTAINING NITRATE GLASSES. Vinogradov, E. E.; Kirilenko, I. A.; Krasilov, Yu. I.; Lebedev, V. G.; Ryurikov, V. F.; Ellert, G. V. (Inst. of General and Inorganic Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 4, 599-604(Apr 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 4, 701-708(Apr 1974).

Glasses were synthesized in the systems $NaNO_3-Mg(NO_3)_2$, $NaNO_3-Gd(NO_3)_3$, $Gd(NO_3)_3-Mg(NO_3)_2$, and $Mg(NO_3)_2-Sc(NO_3)_3$, activated by UO_2^{2+} or Nd^{3+}. On the basis of an investigation of the absorption and luminescence spectra of uranyl in nitrate glasses, it is concluded that in the nitrate matrix uranyl is present as the fairly stable complex $[UO_2(NO_3)_3]^-$ with an insular structure. Energy transfer $UO_2^{2+} \rightarrow Nd^{3+}$ in the nitrate matrix takes place only at short distances and is effected predominantly by an exchange-resonance mechanism. (4 tables) (auth)

9294 PRINCIPLE OF REACTIVE INDEPENDENCE IN RADIATION AND PHOTO EXPERIMENTS. Peak, D.; Corbett, J. W. (State Univ. of New York, Albany). Radiat. Eff.; 22: No. 4, 225-227(1974).

The fraction of damage fragments escaping correlated recombination is shown to be the same for a class of experiments in which irradiation is conducted at sufficiently low temperatures that fragment migration is negligible and for a class of experiments in which irradiation proceeds simultaneously with migration and recombination. (auth)

9295 ROOM TEMPERATURE ELECTRON DAMAGE IN CdS. Look, D. C.; Meese, J. M. (Univ. of Dayton, OH). Radiat. Eff.; 22: No. 4, 229-236(1974).

Room temperature electron irradiation of as-grown n-type CdS at 250 keV (between the sulfur and cadmium displacement thresholds) and at 1 MeV (above both displacement thresholds) produces an increase in the concentration of shallow donors but little change in the concentration of net acceptors. The increase in majority carrier concentration due to irradiation is observed to recover almost completely in an annealing stage centered at 250°C. A reverse annealing occurs from 300 to 400°C followed by a recovery from 400 to 600°C. These last two stages also occur in unirradiated samples and are attributed to surface effects induced by high temperature annealing. (auth)

9296 HEAT TREATMENT OF ION IMPLANTED GaAs. Bell, E. C.; Glaccum, A. E.; Hemment, P. L. F.; Sealy, B. J. (Univ. of Surrey, Guilford, Eng.). Radiat. Eff.; 22: No. 4, 253-258(1974).

Rutherford backscattering, electron spectroscopy (ESCA) and transmission electron diffraction were used to analyze SiO_2 or Si_3N_4 encapsulated GaAs specimens, heat treated at 600°C or 750°C. The nitride layer is found to be the better of the two encapsulants as it inhibits oxygen in-diffusion and the formation of β-Ga_2O_3. Lattice damage caused during ion implantation is found to enhance the formation of Ga_2O_3 in specimens encapsulated with SiO_2, and it is concluded that after heat treatment of these specimens, oxygen may be the dominant impurity. (auth)

9297 ELECTRON IRRADIATION DAMAGE IN SILICON CONTAINING HIGH CONCENTRATIONS OF BORON–LITHIUM PAIRS. Newman, R. C.; Totterdell, D. H. J. (Reading Univ., Eng.) J. Phys., C (London); 7: No. 18, 3418-3426(21 Sep 1974).

Silicon containing high concentrations of boron of up to 2×10^{19} cm^{-3} was compensated by lithium diffusion and then irradiated in stages at 300 K by 2 MeV electrons. Infrared local mode absorption measurements show that the latter treatment destroys $[B^-(s)-Li^+(i)]$ pairs. Initially the boron is displaced into interstitial sites, but aggregation must occur in the later stages while the lithium forms precipitate particles which give rise to optical scatter loss. The observations are compared with previous results for irradiated boron-doped crystals compensated with substitutional donors or for uncompensated samples. (auth)

9298 RADIATION-INDUCED COLORATION IN KBr CRYSTALS SUBJECTED TO AC ELECTRIC FIELDS. Govinda, S. (Indian Inst. of Tech., Kharagpur). J. Phys., C (London); 7: No. 20, L374-L378 (21 Oct 1974).

Optical absorption and thermoluminescence (TL) output measurements were made on KBr single crystals treated in a high alternating (50 Hz) electric field and irradiated with x-rays at room temperature. A substantial enhancement of both the F-center concentration and the thermoluminescence light output was observed in AC-field treated samples upon x-irradiation. The effect of AC-field treatment on the F-center growth curves is also reported. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 8172.

Disposal and Storage

Refer also to abstracts 8323, 8616, 8658, and 8886.

9299 (BNWL-1712) STUDY OF SOIL WATER POTENTIAL AND TEMPERATURE IN HANFORD SOILS. Hsieh, J. J. C.; Reisenauer, A. E.; Brownell, L. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-2130. 78p. Dep. NTIS $5.45.

A knowledge of the movement of precipitation water in the arid soil of the Hanford Reservation is important in the evaluation of long-term waste management practices. This document describes in detail the construction and installation of a string of thermocouple psychrometers and diode temperature transducers in the soil between the soil surface and the groundwater table on the Hanford Reservation. The results of fifteen months of data gathering from these instruments indicate that moisture movement in the soil profile, if any, is extremely small. (auth)

9300 MEASURES FOR A SAFE STORAGE OF RADIOACTIVE WASTES. Umwelt (Inform. Bundesmin. Inn.); No. 28, 7-8(Jan 1974). (In German).

A brief outline of the governmental tasks which are to be set up in the Federal Republic of Germany with respect to the safe storage of radioactive wastes is presented. (GE)

Handling Equipment and Procedures

9301 NUCLEAR SAFETY PROGRAM AT DOW CHEMICAL COMPANY'S ROCKY FLATS PLANT. Part II. Schuske, C. L.; McCarthy, J. D. (Dow Chemical Co., Golden, CO). Nucl. Safety; 15: No. 6, 723-731(1974).

The second part of a two-part article on the nuclear safety program at Dow Chemical Company's production and research complex at Rocky Flats, Golden, Colo. is presented. Experimental and computational programs are discussed. The program has contributed data on the criticality parameters needed in the design of new equipment and facilities, as well as evaluation of existing facilities. The data have resulted in unique equipment designs, such as metal-melting crucibles and storage facilities in which doubling and tripling of process batches not previously permitted have been safely accomplished. These innovations have consequently led to monetary savings in handling of fissile materials. (auth)

Transportation

9302 SOME PROBLEMS ON TRANSPORTATION OF SPENT FUELS FROM NUCLEAR POWER STATION. Kuramoto, M. (Science and Technology Agency, Tokyo). Genshiryoku Kogyo; 20: No. 4, 27-35(Apr 1974). (In Japanese).

In face of the current energy crisis, Japan must inevitably depend on nuclear energy. Differing from the case of thermal power plants, however, the spent fuel from nuclear power plants must be processed. Herein arises the need for its transportation to a reprocessing facility. After reviewing this background, the measures taken in Japan for the problem of spent fuel transportation and the technological aspects of containing radioactive spent fuel in transit are discussed. In the Japan Atomic Industrial Forum, studies on spent fuel transportation have been made and some suggestions and overseas inspections carried out. Since spent fuel is highly radioactive, its container during transport must retain absolute integrity. (JA)

9303 EXPERIENCE IN ORGANIZATION OF SANITARY-RADIOMETRIC CONTROL AT THE STAGE OF TRANSPORTATION OF SOLID RADIOACTIVE WASTES. Maslovskii, R. Ya.; Mamin, A. I. Gig. Sanit.; No. 10, 96-97(Oct 1974). (In Russian).

The sanitary-radiometric control during transportation of solid radioactive wastes consists primarily in the determination of the concentration of radioactive materials in the atmosphere of the automated cabin during its transport. The specially designed apparatus and devices for monitoring and control of the cabin atmosphere are briefly described. (JSR)

9304 SHIPPING CASK NEUTRON AND HEAT SHIELD. Irvine, A. R. (to United States Atomic Energy Commission). US Patent 3,851,179. 26 Nov 1974. Filed date 5 Feb 1974. 6p.

This invention provides for a shield for radioactive materials shipping containers or casks to shield external heat generated by accidental fire from the contents and to shield the external environment of the cask from escape of neutrons generated by the contents. The shield is a multiplicity of metal-clad, metal-housed slabs or beads comprising a lithium hydroxide and sodium hydroxide mixture. Neutron shielding is provided by the relatively favorable neutron shielding properties of the component elements. Heat absorption from an external source is retarded by multiple effects. In the original metal-clad solid state, the hydroxide mixture does not contact the outer metal housing thus minimizing conduction, it cannot transfer heat by convection, and it provides a heat sink by means of heat of fusion at a suitably low temperature. Once the hydroxide is molten and expanded, these conditions are all countered providing a path for release of internally generated heat. (Official Gazette)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 9684.

9305 (JINR-P16-8175) CONDUCTING INDIVIDUAL DOSIMETRIC CONTROL AT THE ACCELERATING INSTALLATION OF THE JINR. Komochkov, M. M.; Salatskaya, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of Radiation Safety). 1974. 23p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

Tests on the dosimetric control of the radiation received by workers at the nuclear physics installations of the JINR are generalized. The control data takes into consideration irradiation by β particles (3.5 MeV > E_β > 0.1 MeV), x rays, and γ radiation (3.0 MeV > E_γ > 0.02 MeV), and neutrons in the energy interval from a fraction of an eV up to a hundred MeV. The individual dosimeters, irradiated behind the accelerator shield under conditions of soft neutron spectra, close to the most probable dose, agreed with the results obtained by other instruments in the same conditions. During control of the individual dose in a field of relativistic neutrons it is necessary to apply corrections to the results. (tr-auth)

9306 HIGH–CURRENT PULSED ELECTRON ACCELERATOR WITH AN ANNULAR BEAM. Avramenko, M.I.; Glukhikh, V.A.; Gusev, O.A.; Komar, E.G.; Komarov, O.L.; Kuznetsov, V.S.; Perlin, A.S.; Svin'in, M.P. (D. V. Efremov Scientific–Research Institute of Electrophysical Apparatus, Leningrad). Sov. Phys.–Tech. Phys. 19: No. 3, 368-370 (Sept 1974).

Certain questions related to the design and construction of a high–current pulsed accelerator with a pulse length of 10^{-4} sec, a beam current of $2 \cdot 10^4$ A, and an electron energy of 1 MeV are discussed. The pulsed accelerating voltage is produced by an electrical solenoid in which energy from an auxiliary power supply is stored with a high–speed current switch. It is shown that an annular thermionic cathode should be used to produce a beam having the specified parameters. The focusing and maintenance of the annular structure of the beam are achieved by means of the inhomogeneous magnetic field of the solenoid. (auth)

9307 400 GeV SYNCHROTRON TAKING SHAPE. CERN Cour.; 14: No. 12, 419-423(Dec 1974).

The status of the 400-GeV CERN proton synchrotron is described, and progress on the construction of some of the components including magnets, control system, and γf system is outlined. (WHK)

9308 (KEK-73-10, pp 273-305) LOS ALAMOS MESON PHYSICS FACILITY. Swenson, D. A. (Los Alamos Scientific Lab., NM). Dec 1973.

From proceedings for high energy physics; Ibaraki, Japan (17 Jul 1973).

The construction, operation, facilities, research program, and status of the Los Alamos Meson Physics Facility are outlined. (WHK)

9309 (KHFTI-74-18) THEORETICAL AND EXPERIMENTAL SIMULATION OF ELECTRON ACCELERATION WITH REGULAR WAVE FIELD OF THE PLASMA WAVEGUIDE. Egorov, A. M.; Fainberg, Ya. B.; Kurilko, V. I.; Tolstoluzhskii, A. P.; Kivshik, A. F.; Bolotin, L. I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1974. 32p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

The plasma waveguide can be used as a linear accelerator system. Experimental investigations confirm the theoretically predicted wave type of the electron capture and acceleration with slow wave field of the plasma waveguide. Measurements performed in the accelerated electron spectra showed a good coincidence with principal theoretical assumptions of dispersion relations, accelerating field intensity, and capture efficiency. Nonlinear effects occurring at large levels of ultrahigh frequency power do not prevent the processes of particle–field interaction of the slow plasma guidewave. (auth)

9310 STATISTICAL PROPERTIES OF SYNCHROTRON RADIATION. Bénard, C.; Rousseau, M. (Laboratoire d'Etude des Phénomenes Aléatoires, Bât. 210, Université Paris–Sud, 91405 Orsay, France). J. Opt. Soc. Am. 64: No. 11, 1433-1444 (Nov 1974).

Synchrotron radiation has been used as a source for spectroscopic experiments in many countries. In this paper, the statistical properties of a light pulse emitted by an electron pulse in a storage ring or a synchrotron are studied in a classical formalism. The field is shown to be gaussian for every wavelength. The coherence time of the filtered synchrotron radiation is calculated. (auth)

Auxiliaries and Components

Refer also to abstracts 8785 and 10158.

9311 (BMFT-FB-T-73-04) TECHNOLOGY OF SUPERCONDUCTING LARGE MAGNETS IN HIGH-ENERGY PHYSICS. Albrecht, C.; Berger, D.; Franksen, H.; Fuchs, W.; Hollfelder, M.; Kuckuck, H.; Kullmann, D.; Maier, R. G.; Parsch, C. P.; Streibl, B. (Bundesministerium fuer Forschung und Technologie, Bonn (F.R. Germany); Zentralstelle fuer Luft- und Raumfahrtdokumentation und -information, Muenchen (F.R. Germany)). Apr 1973. 138p. (In German).

Technological fundamentals have been envolved for the construction of reliable superconducting magnets of optimum design for high-energy physics, i.e., determination of the low-temperature properties of materials, further development and improvement of conductor types commercially available, construction of test coils, and magnet prototypes for the testing of winding techniques. Computer programs have been compiled permitting the calculation of all important data. The development, testing and improvement of ancillary apparatus, such as power supply units, magnet monitoring devices and safety systems are also discussed. (auth)

Ion Optics and Field Calculations

9312 BEAM FOCUSING IN AN ACCELERATOR WITH INDUCTIVE ENERGY STORAGE. Glukhikh, V.A.; Gusev, O.A.; Komar, E.G.; Kuznetsov, V.S.; Svin'in, M.P.; Fidel'skaya, R.P. (D. V. Efremov Scientific–Research Institute). Sov. Phys.–Tech. Phys. 19: No. 3, 366-367 (Sept 1974).

Questions related to the maintenance and focusing of a beam in an accelerator having inductive energy storage are examined. Equations are derived and curves are plotted to determine beam and accelerator parameters such that the charged–particle beam is not cut off or defocused. (auth)

9313 FOCUSING OF AN ASTIGMATIC BEAM BY A DOUBLET AND A SYMMETRIC TRIPLET OF QUADRUPOLE LENSES. Chetvertkov, V. I. Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 1, 1-2(Jul 1974).

Translated from Zh. Tekh. Fiz.; 44: No. 1, 3-5(Jan 1974).

Using a matrix method analytic expressions are obtained in the semithin-lens approximation for the optical parameters and gradients necessary to focus astigmatic beams for given lens geometries and object and image positions. (auth)

9314 A METHOD OF TUNING CHARGED-PARTICLE BEAM TRANSPORT SYSTEMS. Flatte, S. M.; Seiden, A. (California Univ., Santa Cruz (USA)); Bangerter, R. O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Instrum. Methods; 120: No. 2, 205-210(1 Sep 1974).

A general method is given for tuning an operating charged-particle beam with maximum efficiency (least number of iterations). The method involves finding the optimum linear combinations of magnet strengths to vary during the tuning process. (auth)

Storage Rings

Refer also to abstract 9703.

Experimental Facilities

Refer also to abstracts 8776, 8778, and 8795.

9315 (KEK-73-10, pp 141-173) DESIGN OF BEAM LINES AND KEK BEAM LINES. Maki, A. Dec 1973.

From proceedings for high energy physics; Ibaraki, Japan (17 Jul 1973).

A review of beam optics and beam line elements under construction of the KEK 8-GeV synchrotron is given. Some problems encountered in the beam line design are outlined. (WHK)

9316 TRITIUM TARGET FOR INTENSE NEUTRON SOURCE. Booth, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nucl. Instrum. Methods; 120: No. 2, 353(1 Sep 1974).

An earlier report described a rotating target for an intense source of 14 MeV neutrons. For a fresh target, the source strength was 2×10^{12} neutrons/s. The source strength decreased to half its initial value in about 100 h of operation. This source has been used extensively for biomedical research and for studies of radiation damage in materials of interest to fusion reactors. For both applications higher source strength and longer target life are desirable. This note presents the results of attempts to accomplish this. In the earlier work about 8 mA of atomic deuterons at 400 keV bombarded the target. To increase the source strength the beam current has been increased by a factor of two. To increase the target life the diameter of the rotating target was increased from 14 to 21 cm. (auth)

9317 A SIMPLE LABORATORY SOURCE OF 14 MeV NEUTRONS. Jeremie, H.; Deguise, J. C.; Baltar, J. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire). Nucl. Instrum. Methods; 120: No. 2, 355-356(1 Sep 1974).

A simple easy-to-operate accelerator of 100 kV deuterons has been built to yield neutrons through the d(t,α)n reaction. It is intended to be used mainly for counter-calibration and demonstration purposes and yields ~10^7 neutrons/4πs. (auth)

9318 DESIGN CONSIDERATIONS OF A SIMPLE DEUTERIUM GAS TARGET FOR NEUTRON PRODUCTION FOR THERAPY WITH CYCLOTRONS. Chaudhri, M. A. (Islamabad Univ., Rawalpindi (Pakistan)). Nucl. Instrum. Methods; 120: No. 2, 357-358(1 Sep 1974).

It has been shown that a 20 cm long cell, containing only a few atmospheres of deuterium, would produce a suitable neutron beam for therapy with cyclotrons of different sizes. (auth)

9319 HIGH-PRESSURE GAS TARGET OF MODULAR DESIGN. Webb, D. V.; Peterson, G. A.; Szalata, Z. M.; Kan, P. T. (Massachusetts Univ., Amherst (USA)). Nucl. Instrum. Methods; 120: No. 2, 359-361(1 Sep 1974).

A relatively background-free, inexpensive, and easily manufactured gas target is described. It has window foils that can be selected to match the working pressure of the gas, or that can be replaced when they are found to be defective. The target was developed for inelastic electron scattering from ^{3}He using a magnetic spectrometer. It has been used with average beam currents of about 10 μA and a peak beam current of about 10 mA. A rectangular target shape was chosen rather than a cylindrical one, because for the same length necessary to exclude the entrance and exit foils from the spectrometer acceptance solid angle, the rectangular shape has a smaller internal volume. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 9476, 9694, 9699, 9825, and 10058.

9320 ASTROPHYSICAL IMPLICATIONS OF COSMIC–RAY ANTIPROTONS. Gaisser, T.K.; Levy, E.H. (Bartol Research Foundation of The Franklin Institute, Swarthmore, Pennsylvania 19081). Phys. Rev. D 10: No. 6, 1731-1735 (15 Sept 1974).

The production and propagation of secondary cosmic–ray antiprotons is discussed. The flux expected on the basis of the usual picture of cosmic–ray propagation, including an energy–dependent confinement time, is calculated. It is also pointed out that kinematical features of the expected secondary–antiproton spectrum provide a possible way to discriminate betwen secondary antiprotons and a hypothetical primary $\bar{p}$ component between the cosmic radiation. (auth)

9321 OBSERVATION PROJECT FOR MULTI-DIRECTION COSMIC RAY MESONS AT THE DEPTH OF 120 MWe. Ueno, H. (Nagoya Univ., Japan). pp 134-137 of International Magnetosphere Study Symposium. Tokyo; Tokyo Univ. (1973). (In Japanese)

From symposium on international magnetosphere study; Tokyo, Japan (21 Jun 1973).

The purpose of this project is to estimate the property of space at 1 AU by observing the variation of cosmic-ray intensity underground. This paper reports on the results of the preliminary measurement of cosmic-ray intensity in a tunnel. The measurement was performed at Uekaneyama Tunnel of Japan National Railway. Pulse-height distribution due to cosmic-ray and natural activity were measured with plastic scintillators. The intensity of cosmic rays was $^{1}/_{30}$ of that measured at the surface. The noise due to gamma rays from rocks did not exceed the expected value. Three layers of detectors were arranged in the tunnel. This arrangement reduced the noise due to gamma rays. As reference data, the pressure-corrected cosmic-ray intensity in universal time recorded with a Swarthmore neutron monitor and with underground muson telescopes at Bolivia, Embudo, and Socorro are shown. The Forbush decrease on Aug. 5, 1972 was clearly seen in these measurements of underground mesons. The energy spectra of cosmic-ray variation and the energy dependence of the components of cosmic rays are shown. (JA)

9322 PROJECT OF OBSERVATION OF COSMIC RAY. II. Mori, S. (Shinshu Univ., Nagano, Japan); Sagisaka, S.; Yasue, S.; Ichinose, M. pp 183-185 of International Magnetosphere Study Symposium. Tokyo; Tokyo Univ. (1973). (In Japanese)

From symposium on international magnetosphere study; Tokyo, Japan (21 Jun 1973).

The purpose of the present observation project is to investigate magnetic fields and plasma structure in the solar system for the range between 1 and 0.1 AU which corresponds to the energy of 10 eV. This has been done by the continuous observation of cosmic-ray intensity at 30 m.w.e. The characteristic features of the present project are as follows; (1) finer structure can be studied by increasing the counts of cosmic rays, (2) it is possible to obtain the quantity which is not affected by atmospheric effect, and (3) the mechanism of variation of cosmic rays can be seen by observing components in various directions. A multi-direction meson monitor is set at Sango tunnel. The terrestrial shape above the tunnel is spherical. The depth of earth is about 14 m, and the density is 2.2 g/cc. This depth corresponds to 30.8 m.w.e. This value is in agreement with the value obtained from the observation of cosmic-ray intensity. The multi-direction meson monitor used for the observation consists of several scintillation detectors of 1 m^2 which are arranged as two layer trays. By counting the coincident counts of two detectors, it is possible to measure the intensity in various directions. The counting rate in the vertical direction was 300,000/hour, and that in the inclined direction was 150,000/hour. Both counting rates are increased in comparison with previous observational values. The present total area of the meson meter is increased to 25 m^2. This area can catch the counting rate of 450,000/hour in the vertical direction. (JA)

9323 OBSERVATION PROJECT OF COSMIC RAY. I. Kanno, T. (Fukushima Univ., Japan). pp 177-182 of International Magnetosphere Study Symposium. Tokyo; Tokyo Univ. (1973). (In Japanese)

From symposium on international magnetosphere study; Tokyo, Japan (21 Jun 1973).

This paper reports on the observation project of cosmic rays during IMS. The continuous observation of cosmic-ray components has been carried out at various points in Japan. Apparatuses were ionization chambers, meson monitors, and neutron monitors. In IMS, new projects are considered. Study on the modulation of primary cosmic-ray particles of 10^{11} to 10^{12} eV by making continuous observation at 120 m.w.e. underground is considered by a group at Nagoya University. Improvement of the observation system for the neutron intensity of cosmic rays at Fukushima University is considered. The steady observation at Fukushima University has been performed since 1971, and the Forbush decrease in June, 1972 and the phenomena in Aug. 1972 were recorded. At present, observation is carried out with one set of counters, and the loss of observation cannot be avoided because of the trouble of apparatuses. Another set is in preparation, and the observation of multiplicity is planned. Exchange of data between Fukushima and Seoul, Korea is also considered. Observation of the intensity of cosmic-ray neutrons at Morioka is considered. The observation at Morioka is not sufficient in accuracy. A program of observation with a large neutron monitor is planned. When this project starts, a network of observation along 140°E longitude becomes complete. (JA)

9324 RELATIVISTIC SOLAR COSMIC RAYS. Pomerantz, M. A. (Franklin Inst., Swarthmore, PA). J. Franklin Inst.; 298: No. 4, 363-383(Oct 1974).

Solar and galactic cosmic rays are of profound astrophysical interest. One facet of contemporary cosmic ray research utilizes these energetic particles as space probes for studying the characteristics of the solar-controlled interplanetary medium, the heliosphere, which is essentially the extension of the solar corona to a considerable distance beyond the orbit of earth. Solar cosmic ray observations in particular contribute to an understanding of the earth's environs, the interplanetary medium, and the sun itself. Appropriately deployed ground-based cosmic ray detectors utilize the earth as a spacecraft for carrying out experiments that are far beyond the capacity of artificial satellites. In interpreting the observations, however, the effects of the geomagnetic field and of the atmosphere must be taken into account by appropriate analytical procedures. Theoretical models account for many of the characteristics of the observed modulations and anisotropies, which manifest themselves as temporal or spatial intensity variations. Analysis of the measurements in terms of various models provides an understanding of the physical mechanisms, as well as the determination of the relevant parameters. Properties of solar cosmic rays that were investigated include spectra, angular distributions, transport mechanisms and the acceleration to relativistic energies. (auth)

9325 COSMIC RAYS: ASTRONOMY WITH ENERGETIC PARTICLES. Meyer, P. (Univ. of Chicago); Ramaty, R.; Webber, W. R. Phys. Today; 27: No. 10, 23-30; 32 (Oct 1974).

The discussion of cosmic ray astronomy with energetic particles covers the observations, cosmic-ray sources, interactions and propagation, the electron–positron component, and the key directions of cosmic ray research in the intermediate future. (JFP)

9326 U, Th AND EXTINCT ^{244}Pu IN THE PHOSPHATES OF THE ST. SEVERIN METEORITE. Crozaz, G. (Washington Univ., St. Louis, Mo. (USA)). Earth Planet. Sci. Lett.; 23: No. 2, 164-169(Sep 1974).

Previous work (G. J. Wasserburg, J. C. Huneke and D. A. Burnett, 1969) on isolated crystals of whitlockite in the meteorite St. Severin has shown that this mineral concentrates U but not to the extent necessary to account for the total uranium. The microdistributions of the total Th and U were measured in polished rock sections by the fission track method. Approximately 95% of the Th and U was found to be distributed in the matrix while the remaining 5% was found to be concentrated in two species of phosphate crystals, mostly whitlockite but also in much rarer chlorapatite. The Th/U ratio was measured in seven crystals of whitlockite and one crystal of chlorapatite. The values are respectively (11.8 ± 1.4) and (1.5 ± 0.5). Comparison with rare-gas studies indicates that ^{244}Pu probably followed Th geochemically in the whitlockite. (auth)

9327 ON THE POSSIBILITY OF A GEOCORONAL CONTRIBUTION TO THE CELESTIAL SOFT X-RAY BACKGROUND. Mack, J. E. (State Univ. of New York, Buffalo (USA)); Kondo, Y. (Astrophysics Section, NASA-Lyndon B. Johnson Space Center, Houston, Texas, USA). Astrophys. Space Sci.; 30: No. 1, 123-126 (Sep 1974).

The possibility is investigated that a significant fraction of the x-ray background in the energy range 0.2 to 0.28 keV originates in the geocorona through bremsstrahlung. It is concluded that the geocoronal flux must be substantial at some times and the possibility exists that an observable geocoronal background exists at all times. The existing data on the soft x-ray background is found to be compatible with the hypothesis of a geocoronal component. (auth)

9328 PRODUCTION AND PROPAGATION OF COSMIC RAY H^2 AND He^3 NUCLEI. Ramadurai, S.; Biswas, S. (Tata Inst. of Fundamental Research, Bombay (India)). Astrophys. Space Sci.; 30: No. 1, 187-213(Sep 1974).

The results of detailed calculations on the production of ^2H and ^3He nuclei by cosmic-ray protons and helium nuclei in interstellar medium are presented. The flux and energy spectra of these nuclei as well as those of cosmic ray ^1H and ^4He nuclei in the vicinity of the earth are calculated. For this purpose the source spectra are assumed to be in the form of a power law in total energy per nucleon with an additional velocity dependent term. This spectrum denoted as Fermi Spectrum is about midway between the power-law spectrum in rigidity and in total energy per nucleon. The fluxes are calculated taking into account: (1) energy dependent cross-sections of thirteen nuclear reactions of cosmic-ray protons and helium nuclei with interstellar ^1H and ^4He leading to the production of ^2H and ^3He nuclei, (2) angular distributions and kinematics of these reactions, (3) ionization loss of the primary and secondary nuclei in interstellar medium, (4) elastic collisions of cosmic-ray protons and helium nuclei, (5) distributions of cosmic-ray path-lengths in interstellar space as in gaussian and exponential forms, and (6) interplanetary modulation of cosmic rays from the numerical solution of the complete Fokker–Planck equation describing the diffusion, convection, and adiabatic deceleration of cosmic-ray nuclei in the solar system. On comparing the calculated values of $^2H/^4He$ and $^3He/(^3He-^4He)$ as a function of energy with the observed data of several investigators, it is found that agreement between the calculated values and most of the observed data is obtained on the basis of: (a) source spectrum in the form of "Fermi" Spectrum, (b) distribution of path-lengths as in the gaussian form with a mean value of 4 g cm^{-2} of hydrogen or as in exponential form with leakage path length of 4 g cm^{-2}. (auth)

9329 MEASUREMENTS OF ATMOSPHERIC γ RAYS BETWEEN 10 AND 200 MeV. Kinzer, R.L.; Share, G.H.; Seeman, N. (Laboratory for Cosmic Ray Physics, Naval Research Laboratory, Washington D.C. 20375). J. Geophys. Res. 79: No. 31, 4567-4574 (1 Nov 1974).

The intensity and energy spectrum of secondary γ radiation near the top of the atmosphere have been measured at cutoff rigidities of 4.5 and 11.5 GV. These measurements were made with a balloon–borne telescope sensitive to photons between 10 and 200 MeV and consisting of a stack of nuclear emulsions used in conjunction with a wide–gap spark chamber. The rates of growth of γ rays in this energy range, as a function of atmospheric depth, are $(2.54\pm0.56)\times10^{-3}$ and $(1.17\pm0.32)\times10^{-3}$ γ/cm^2 s g cm^{-2} at 4.5– and 11.5–GV cutoffs, respectively. The differential spectrum has been determined with an energy resolution of $\simeq(+30, -16)$ % and is consistent with previous measurements at 4.5 GV made at higher and lower energies. However, this is the first measurement that clearly exhibits the two–component nature of the atmospheric γ ray spectrum. Differences existing between the measured spectral shapes and calculations are discussed. (auth)

9330 THE FORCE FIELD EQUATION FOR THE PROPAGATION OF GALACTIC COSMIC RAYS APPLIED TO NEUTRON MONITOR MEASUREMENTS. Moraal, H. (CSIR Cosmic Ray Research Unit, Potchefstroom University for CHE, Potchefstroom, South Africa); Henning, J.J.; Stoker, P.H. J. Geophys. Res. 79: No. 31, 4559-4566 (1 Nov 1974).

The modulation of galactic cosmic rays is described in terms of a generalized force field equation for a mixture of particles to which a neutron monitor is sensitive. The force field solution is used to derive the modulation parameters from observations inside the atmosphere in an energy region well above the effective high–energy limit of satellite observations. The parameters are calculated in the rigidity range ~2–15 GV and provide statistically accurate extensions in rigidity to existing results. The limitations of the modified convection–diffusion approximation for modulation studies in the rigidity range ~2–15 GV are indicated. (auth)

9331 HIGH ENERGY INTERACTIONS AND THE LONGITUDINAL BEHAVIOUR OF GIANT AIR SHOWERS. Goorevich, L.; Peak, L. S. (Univ. of Sydney). J. Phys., A (London); 7: No. 14, 1777-1792(21 Sep 1974).

A realistic model of nucleon and pion interactions is developed incorporating fast development, possible formation of many ionization centers and production of $N\bar{N}$ pairs. This model is used to develop air showers with proton primaries via the technique of successive generations. Comparison of the longitudinal properties of the resulting showers with experimental data at sea level suggests significant nucleon–anit-nucleon production (becoming more dominant for increasing energies) and the need for an even faster development. (auth)

9332 COSMIC RAY ORIGIN ABOVE 10^{17} eV. Strong, A. W.; Wdowczyk, J.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 14, 1767-1776(21 Sep 1974).

An analysis is made of the implications of assuming an extragalactic origin for cosmic rays above 10^{17} eV. The effect of the blackbody radiation on the propagation of extragalactic protons is examined in some detail and the expected spectral shape is derived for alternative assumptions about the origin and confinement of the particles. The possibility of distinguishing between various models using contemporary extensive air shower arrays is considered. (auth)

9333 COSMIC RAY DIURNAL VARIATION ON A DAY-TO-DAY BASIS. Ananth, A. G.; Agrawal, S. P.; Rao, U. R. (Physical Research Lab., Ahmedabad, India). Pramana; 3: No. 2, 74-88 (Aug 1974).

From a careful examination of the diurnal variation of cosmic ray intensity at high energies and the interplanetary field characteristics, the average characteristics of diurnal variation were recently explained by us in terms of a balance between outward convection and field aligned diffusion, the latter arising out of a positive radial density gradient. This new concept is extended to explain the large variability observed in the diurnal variation on a day-to-day basis, and it is further demonstrated that the measurement of diurnal anisotropy characteristic of cosmic ray particles on a day-to-day basis can be used directly to infer the nature and scale sizes of interplanetary field parameters. Comparing with the magnetic field vector, it is shown that this simple concept holds good on more than 80% of days. On the rest 20% of days which have a predominant morning maxima, the diurnal anisotropy characteristics seem to indicate the presence of a significant component of transverse diffusion current in addition to the normal convection and diffusion flow. Such days are found to be present in the form of trains of consecutive days and are found to be associated with abrupt changes in the interplanetary field direction having scale sizes >4 hr. The value of $K_\perp/K_\parallel$ which is normally about ≤ 0.05 is found to be ≈ 1.0 on nonfield aligned days. (auth)

Stars

Refer also to abstracts 9413, 9478, 9480, 9486, 10031, 10112, and 10116.

9334 WAVE FIELDS OUTSIDE A COLLAPSING CHARGED STAR. Sibgatullin, N. R.; Alekseev, G. A. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 67: No. 4, 1233-1249(Oct 1974). (In Russian).

It is proved that the simultaneous set of Einstein–Maxwell equations linearized around the Nordstrem–Reisner solution is equivalent to four independent second-order equations. For a fixed angular harmonic each of the equations (following a Fourier transformation with respect to time) has the form of a one-dimensional Schroedinger equation for a particle in a potential field which vanishes at $\pm\infty$. For waves moving in a field with an event horizon decay laws are found for multipole radiation "tails" initially emitted by the collapsing body near the event horizon. The corresponding Price formulas are corrected in the case of absence of a charge. The resultant field of a charged collapsar can be described by a Kerr–Newman solution. It is demonstrated that if the star charge q equals its mass m the radiation asymptotic behavior qualitatively changes. For $q^2 \approx m^2$ a fixed ratio between amplitudes of the electromagnetic and gravitational waves arises in the "tail" of radiation transmitted by the field of a charged collapsar. The intermediate asymptotic behavior of radiation which precedes that described above is found. (auth)

9335 CNO ABUNDANCES AND HYDRODYNAMIC MODELS OF THE NOVA OUTBURST. II. 1.00 $M_\odot$ MODELS WITH ENHANCED CARBON AND OXYGEN. Starrfield, S. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York); Sparks, W.M.; Truran, J.W. Astrophys. J. Suppl. Ser. 28: No. 261, 247-270 (Aug 1974).

We have evolved a large number of models of thermonuclear runaways in the hydrogen–rich envelopes of 1.00 $M_\odot$ carbon–oxygen white dwarfs, exploring the consequences of variation in the CNO abundance, the initial luminosity, and the mass in the envelope. Models characterized by enhanced CNO abundances satisfy the observations of the common–nova outburst. They eject from 10^{27} to 10^{29} g moving with velocities of 200–2400 km s^{-1}: kinetic energies of $10^{44}-10^{45}$ ergs. The theoretical light curves are similar to the early stages of observed light curves of common novae. All the models that eject of shell achieved peak energy generation of at least 5×10^{15} ergs g^{-1} s^{-1} and we present an argument which demonstrates the necessity of this high a value. The increased energy generation results from the nuclear enhancement of ^{12}C and ^{16}O in the deepest layers of the hydrogen–rich envelope. Because of this enhancement, the shell is not shock ejected but rather expelled by the release of energy as the β^+–unstable nuclei decay at long times (10^3 s) after peak temperature has occurred in the envelope. This behavior leads to our prediction that ^{15}N will be the most abundant of the CNO nuclei in the ejected material and ^{13}C and ^{17}F will be enhanced far above solar values. As a result of our study we can now present explanations of Kukarkin and Parenago's relationship, the continuous ejection of mass which is observed for long times after the initial outburst, and the correlation between maximum magnitude and the decline to minimum. Further, we show how the presence of a ring of material surrounding the white dwarf may provide a natural explanation of the characteristics of the dwarf–nova outburst. Our results thus demonstrate how a single hypothesis—a thermonuclear runaway—can explain either a dwarf–nova outburst or a common–nova outburst depending upon the initial structure of the cataclysmic binary system. (auth)

9336 SEARCH FOR BLACK HOLES. Thorne, K. S. Sci. Amer.; 231: No. 6, 32-43(Dec 1974).

Evidence leading to the conclusion that there is a black hole in the center of Cygnus X-1 is described. (JFP)

9337 MOLECULES IN STARS. Wallerstein, G. (Univ. of Washington, Seattle). pp 125-138 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

Molecular lines and bands are found in stars of types F, G, K, M, R, N, and S. Only within the past 10 years have quantitative analyses of stars with molecular bands been possible. In analyzing cool stars one-layer atmospheres are inadequate. Most model atmospheres consist of some 20 or 30 layers between optical depth 0.001 and 10. However, it is suggested that for many purposes models with only 4 or 5 layers would be sufficient. The presence of OH and H_2O in red giants is discussed. A kinematic model is established as a basis for the study of the phenomena involved. (IAA)

9338 ADVANCED EVOLUTION OF GLOBULAR CLUSTER STARS. Zinn, R. J. New Haven; Yale Univ. (1974). 160p. University Microfilms Order No. 74-25,792. Thesis (Ph.D.).

Twenty-seven globular clusters have been searched for stars that lie to the left of the giant branch and above the horizontal branch in the HR-diagram. Stellar structure computations, by other authors, indicate that stars cross this region of the HR-diagram while evolving from the horizontal branch to the white dwarf stage. The stars of interest have brighter U magnitudes than any other cluster stars. This permitted their identification by blinking short exposure U- and V-plates and suggested the name "UV-bright stars." For most of the 156 UV-bright stars found, cluster membership has not been established. Nevertheless, the proximity of many of these stars to the cluster centers makes them likely candidates for membership. (WDM)

9339 ORDER-OF-SCATTERING OF PARTIALLY POLARIZED RADIATION IN INHOMOGENEOUS, ANISOTROPICALLY SCATTERING ATMOSPHERES. I. Fundamentals. Fymat, A. L.; Ueno, S. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Astrophys. Space Sci.; 30: No. 1, 3-25(Sep 1974).

A complete set of transfer equations required for the order-of-scattering analysis of partially polarized radiation in inhomogeneous, anisotropically scattering atmospheres is provided. The equations have been derived for both a local study using the radiative transfer equation and its associated auxiliary equation for the source-matrix, and a global study in terms of the scattering and transmission matrices; they account for the polarity of the scattering medium. Their derivations for the finite order scattering and the finitely cumulative scattering, in particular, have yielded important new equations expressing the invariance principles and the integro-differential recurrences for the scattering and transmission matrices. These novel expressions contain as a special case Bellman et al's (1972) equations for the simpler case of isotropic scattering of unpolarized light in homogeneous atmospheres. (auth)

9340 ON THE FORMATION OF METAL-POOR STARS. Edmunds, M. G.; Wickramasinghe, N. C. (University Coll. of South Wales and Monmouthshire, Cardiff (UK)). Astrophys. Space Sci.; 30: No. 1, L9-L15(Sep 1974).

The expulsion of metal-rich grains from collapsing protostars is considered, and it is concluded that stars of mass greater than 21 $M_\odot$ could be significantly depleted in heavy metals during their formation. (auth)

9341 THE MAIN SEQUENCE STARS AND THE PHOTON-NEUTRINO COUPLING THEORY OF WEAK INTERACTIONS. Nishida, M. (Kyoto Univ. (Japan). Dept. of Physics); Yamasaki, A. (Tokyo Univ. (Japan). Coll. of General Education). Astrophys. Space Sci.; 30: No. 1, 225-231(Sep 1974).

To test the photon–neutrino coupling theory of weak interactions as presented by Bandyopadhyay (1968), detailed models of the main-sequence stars with neutrino emission based on this theory are computed. The models are compared with the observational data, and it is concluded that the photon–neutrino coupling theory would seem to be definitely excluded on astrophysical grounds. (auth)

9342 SCATTERING AND TRANSMISSION MATRICES OF PARTIALLY POLARIZED RADIATION IN A RAYLEIGH ATMOSPHERE BOUNDED BY A SPECULAR REFLECTOR. Ueno, S. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Astrophys. Space Sci.; 30: No. 1, 27-34(Sep 1974).

In a manner similar to that given in a preceding paper (cf. Casti et al., 1970), in this paper it is shown how to get a Cauchy system for the scattering and transmission matrices of the azimuth-independent term of partially polarized light in accordance with Rayleigh scattering in a homogeneous atmosphere bounded by a specular reflector. This set of integro-differential equations for the scattering and transmission matrices is suitable for numerical computation by high-speed digital computers. (auth)

9343 EXACT SOLUTION OF A LINE-TRANSFER PROBLEM IN KERNEL APPROXIMATION. Ueno, S. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Astrophys. Space Sci.; 30: No. 1, 35-41(Sep 1974).

In recent years approximate solutions for line-transfer problems using a kernel representation have been discussed by several authors (cf. Avrett and Loeser, 1966; Hummer and Rybicki, 1967). In this paper, extending an invariant imbedding method to the line-transfer problem with a kernel approximation as a sum of exponentials, it is shown how to get an exact solution of Milne's integral equation for the frequency-independent line source function with the aid of the resolvent kernel. A Cauchy system for an auxiliary function and the resolvent is suitable for numerical computation by means of high-speed digital computers. (auth)

9344 SPACE-CHARGE FLOWS AND ELECTRIC FIELDS IN THE MAGNETOSPHERES OF ROTATING MAGNETIC STARS. Tademaru, E. (Massachusetts Univ., Amherst (USA)). Astrophys. Space Sci.; 30: No. 1, 179-186(Sep 1974).

A method is illustrated for determining self-consistently the spatial distribution of space-charge currents and electric fields close to the surface of a rotating magnetic star. The unique solution for simple geometries shows that the space-charge flow, required to maintain the surface potentials and to bring the surface electric field parallel to the magnetic field to zero, simultaneously sets $E \cdot B$ to zero at all heights above the surface. Thus this result questions the previous estimates of the parallel electric fields near pulsars. (auth)

9345 THE APSIDAL MOTION OF V 380 CYGNI. Battistini, P.; Bonifazi, A.; Guarnieri, A. (Bologna Univ. (Italy)). Astrophys. Space Sci.; 30: No. 1, 163-171(Sep 1974).

Two new times of the minimum allow us to establish, without doubt, the existence of an apsidal motion in this system; the apsidal period being about 1490 years with an error of 11%. More accurate values of the orbital period and of the periods of principal and secondary minima are established. On the basis of these periods a new estimate of the times of minima of Kron's light curve is made. A new light curve which has been obtained is briefly described. (auth)

9346 THE POST-MAIN SEQUENCE EVOLUTION OF A STAR OF 20 SOLAR MASSES TO CORE HELIUM EXHAUSTION. Sreenivasan, S. R.; Ziebarth, K. E. (Calgary Univ., Alberta (Canada). Dept. of Physics). Astrophys. Space Sci.; 30: No. 1, 57-70(Sep 1974).

An evolutionary model of a Population I star of 20 $M_\odot$ and of composition X = 0.70, Y = 0.28, beyond the main sequence and up to core helium exhaustion, is reported. Calculations were carried out to determine the effect of semi-convection using a method of mixing considered physically more appropriate than previous methods. Both the density as well as the temperature stability criteria were employed in parallel calculations and reasons are advanced to prefer the temperature criterion. The results of the model calculations reported here underline the importance of the proper choice of the stability criterion and an appropriate mixing-scheme. In addition it is demonstrated that the loop phenomenon seen in the helium burning evolution of less massive stars is either absent or very unpronounced at 20 $M_\odot$. (auth)

9347 GAMMA–RAY BURSTS FROM MAGNETIC WHITE DWARFS. Chanmugam, G. (Department of Physics and Astronomy, Louisiana State University). Astrophys. J. Lett. 193: No. 2, L75-L76 (15 Oct 1974).

A possible mechanism for the development of convective instabilities, in magnetic white dwarfs, which give rise to γ-ray bursts is suggested. (auth)

9348 EXTENDED HALOS ON PLANETARY NEBULAE. Millikan, A.G. (Research Laboratories, Eastman Kodak Company, Rochester, New York 14650). Astron. J. 79: No. 11, 1259-1259 (Nov 1974).

Limit photographs of a selection of planetary nebulae show extended halos of large diameter on a majority of the limited sample studied. (auth)

9349 RECENT PROGRESS IN LABORATORY ASTROPHYSICS. Garstang, R.H. (Joint Institute for Laboratory Astrophysics, National Bureau of Standards and University of Colorado, and Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302). Astron. J. 79: No. 11, 1260-1268 (Nov 1974).

A survey is given of recent work in laboratory astrophysics, under the headings data centers and evaluation, data publications, analysis of atomic spectra, negative ions, large magnetic fields, experimental atomic transition probabilities, theoretical atomic transition probabilitites, systematic trends and highly—charged ions, collision cross sections, diatomic molecular spectra, polyatomic molecular spectra, length and frequency standards, speed of light, and constancy of speed of light. (auth)

9350 ROTATIONAL VELOCITIES IN NGC 2232. Levato, H. (Observatorio Astronómico, Universidad de la Plata, La Plata, Argentina). Astron. J. 79: No. 11, 1269-1270 (Nov 1974).

Rotational velocities for the brightest members of NGC 2232 are determined. The results show that in the mean, they rotate quite similar to field stars. (auth)

9351 SOME NEW SPECTROSCOPIC BINARY ORBITS IN NGC 6231 AND SCO OB1. Hill, G. (Dominion Astrophysical Observatory, Victoria, British Columbia, Canada); Crawford, D.L.; Barnes, J.V. Astron. J. 79: No. 11, 1271-1279 (Nov 1974).

New spectroscopic orbits for eight stars in Sco OB1 and NGC 6231 have been derived, including those of two double—lined spectroscopic binaries. Another double—lined system has been found (HDE 326331). We urge that light curves be determined for these three systems. An orbit of the Wolf—Rayet star HD 152270, derived by Struve (1944b), is confirmed and another Wolf—Rayet star HD 151932 appears to be constant in velocity. (auth)

9352 THE LUMINOSITY FUNCTION OF THE ZERO—AGE MAIN SEQUENCE. Taff, L.G. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Astron. J. 79: No. 11, 1280-1286 (Nov 1974).

This paper presents a new determination of the luminosity function [$N(M_v)$] of the zero—age main sequence. The result is based on multicolor observations of 62 galactic clusters. A technique which is designed to test the hypothesis of universality by correcting for evolution at the bright end and incompleteness at the faint end is employed. The principal results are (1) if the clusters are divided by the Trumpler classification of richness and concentration class then in each subdivision of the classification scheme there is no reason to reject the hypothesis of universality and (2) when $N(M_v)$ is converted to a mass function the result is a power law $\{\log[n(M)\Delta M] = \text{const.} - p\log(M)$ with $p = 2.74 \pm 0.07$ (s.e.). Also considered are comparisons with some theories of star formation and the method of Salpeter (1955) applied to more recent observational data and stellar models. (auth)

9353 COMPARISON OF A GENERAL CATALOGUE OF COOL CARBON STARS AND THE TWO—MICRON SKY SURVEY. Baumert, J.H. (Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). Astron. J. 79: No. 11, 1287-1289 (Nov 1974).

One—hundred ninety—two carbon stars in A General Catalogue of Cool Carbon Stars have been identified with stars in The Two—Micron Sky Survey (the IRC). Seven of these are new identifications of previously unidentified sources in the IRC. A table is also presented which lists some IRC sources identified with stars which had previously been classified as carbon stars but are not contained in the carbon star catalogue. (auth)

9354 PHOTOELECTRIC UBVRI OBSERVATIONS OF Am STARS. Feinstein, A. (Observatorio Astronómico, Universidad Nacional de La Plata, Argentina). Astron. J. 79: No. 11, 1290-1293 (Nov 1974).

UBVRI photoelectric observations of 103 Am stars are reported. The distribution of points in arrays combining different colors gives the known evidence that most of them have an ultraviolet deficiency. H_β—line measures in 30 stars, combined with additional data, suggest how to obtain the correction which eliminates the blanketing effect. As no deficiency in several color—color diagrams seems apparent, the line blanketing in B, V, R, and I appear to be similar. (auth)

9355 PHOTOMETRIC STANDARDS FOR THE SOUTHERN HEMISPHERE III. Miller, E.W.; McCarthy, C.C. (Steward Observatory, University of Arizona, Tucson, Arizona 85721). Astron. J. 79: No. 11, 1294-1298 (Nov 1974).

Seven new standard UBV photoelectric sequences are presented for Milky Way fields in Monoceros, Puppis, and Vela. Each new sequence contains at least 16 stars and has a faint magnitude limit of at least $V = 15.3$. In addition to the new sequences, three standard sequences previously published by Bok, Bok, and Miller (1972) have been enlarged and extended to fainter magnitudes. Identification charts are provided for all ten fields. (auth)

9356 OCCULTATIONS OF THE PLEIADES: PHOTOELECTRIC OBSERVATIONS AT TONANTZINTLA WITH A DISCUSSION OF THE DUPLICITY OF ATLAS. McGraw, J.T.; Dunham, D.W.; Evans, D.S.; Moffett, T.J. (Department of Astronomy, University of Texas at Austin and McDonald Observatory, Austin, Texas 78712). Astron. J. 79: No. 11, 1299-1303 (Nov 1974).

Occultation traces obtained during an expedition to Mexico on 11 February 1973 and resulting timings are reported. The concept of nominal angular diameter of a spectroscopic binary system is introduced. The traces demonstrate that SAO 76103 is a wide binary, and that SAO 76192 and 76225 are probably binaries. Those obtained for SAO 76228 (Atlas) on this and two other occasions conclusively demonstrate its binary nature. The Atlas results are not compatible with the published spectroscopic orbit and further investigation is essential. (auth)

9357 RADIAL VELOCITY MEASUREMENTS AND SPECTROGRAPHIC ORBITS. Popper, D.M. (Department of Astronomy, University of California, Los Angeles, California 90024). Astron. J. 79: No. 11, 1307-1313 (Nov 1974).

Spectrograms of standard—velocity stars and of spectroscopic binaries are analyzed in attempts to evaluate the magnitude of the random scatter or mean error of radial velocities and to identify causes of the scatter. For sharp—lined standard stars and binaries, a m.e. of about ±1.5 km/sec is found for a single plate with 10.7 Å/mm. Guiding error and effects of optical adjustment of the spectrograph are hesitantly identified as contributing to the m.e., with a minor contribution from disagreement among the lines on a plate. For stars with lines of poorer quality there is a small additional source of scatter only partially accounted for by the additional disagreement between lines on a plate. Correlation between the residuals of velocity for the components of a spectroscopic binary on the same plate indicates that "plate error" common to the two components is only partially responsible for the residuals. Different approaches used in solving for the amplitudes of velocity variation, K_1 and K_2, for double—lined spectroscopic binaries are discussed. It is concluded that, in most circumstances, independent solution for the two amplitudes is preferable to solution for K_1+K_2, K_1-K_2, or K_1/K_2. Some discussion is included on the application of the method of least squares to this problem. (auth)

9358 PARALLAXES OF 20 STARS DETERMINED FROM PLATES TAKEN WITH THE McCORMICK 26—IN. REFRACTOR. Ianna, P.A.; McAlister, H.A. (Department of Astronomy, University of Virginia, Charlottesville, Virginia 22903). Astron. J. 79: No. 11, 1314-1316 (Nov 1974).

Trigonometric parallaxes, proper motions, and photoelectric magnitudes and colors are presented for 20 stars. This is a continuation of previous similar publications in this journal. (auth)

9359 NEW PROPER MOTIONS, STATISTICAL PARALLAXES, AND KINEMATICS OF PLANETARY NEBULAE. Cudworth, K.M. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz, California). Astron. J. 79: No. 12, 1384-1395 (Dec 1974).

New proper motions have been measured for 51 planetary nebulae. These have been combined with motions previously available and used in statistical parallax calculations. The distance scale thus calibrated for optically thin nebulae agrees with that of Seaton (1966). For optically thick nebulae the mean nebular absolute magnitude is $M_n = -2.0$. The distance scales are the same for both of Greig's (1971) classes. The kinematic difference between these classes (Greig 1972) is confirmed but the younger class is not concentrated in spiral arms. The kinematics of both classes are consistent with their being the offspring of Mira variables. The nebulae of brightest absolute magnitude are not those of highest surface brightness. This violates a basic assumption of Seaton (1968) and thus invalidates his recalibration of the distance scale. The nebular absolute magnitudes are most consistent with a nebular evolutionary track which loops upwards (e.g., Seaton 1966) with the optically thick to thin transition occurring before the nebula reaches the peak of the track. The resolved high—velocity nebulae concentrated near $l=0°$ are sufficiently distant to indicate $R_0 \geq 8$ kpc. (auth)

9360 ACHROMATIC DOUBLE—STAR INTERFEROMETRY. Wickes, W.C.; Dicke, R.H. (Joseph Henry Laboratories, Physics

Department, Princeton University, Princeton, New Jersey 08540). Astron. J. 79: No. 12, 1433-1444 (Dec 1974).

A radical modification of the previously described stellar interferometer results in "achromatic" fringe detection. The fractional modulation of the transmitted light flux resulting from high-frequency chopping of the star-image fringe system is independent of wavelength, so that large optical bandwidths may be used without loss of detected fringe visibility. As with the previously described interferometer, a rotating dove prism provides sampling of fringe visibility for all angles of the entrance apertures relative to the star field. An improved technique of alternate observations of a double star and of a single star permits resolution of double stars with substantial magnitude difference between the components. We report observations of the double stars β Del, λ Cyg, λ Cas, and 85 Peg. We have also obtained a tentative resolution of the astrometric binary μ Cas at a magnitude difference of 5.5. (auth)

9361 SPECTROSCOPY OF CIRCUMSTELLAR SHELLS. Treffers, R. R. Berkeley, CA; Univ. of California (1973). 79p. University Microfilms Order No. 74-23,976.

Thesis (Ph. D.).

This thesis is an investigation into the composition of circumstellar dust around cool stars. Spectra are presented of several cool stars in the 10 and 20 micron regions with 2 cm^{-1} resolution. The oxygen-rich stars show excess emission (emission greater than expected from a star alone) features at both 10 and 20 microns. This has been interpreted as emission by dust grains made of some silicate material. Spectra of the carbon stars show an emission feature between 10.3 and 12.6 microns. This is shown to be due to emission by silicon carbide grains in a circumstellar shell. Other unidentified particles are found around both types of stars. These results are consistent with the theoretical calculations of the condensates around cool stars. The problem of correcting for the contribution of the stellar flux in the observed spectra is discussed. Evidence for other types of particles such as graphite is presented. (Diss. Abstr. Int., B)

9362 REVIEW OF THE RESEARCH ON SUPERNOVAE. Zwicky, F. (Hale Observatories, Pasadena, CA). Astrophys. Space Sci. Libr.; 45: 1-16(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Historical review of supernova research, with special attention to the morphological approach. It is shown, in particular, how the method of directed intuition has helped to open up the field of supernovae and how the search for and the research on cosmic implosions and explosions was planned and conducted over the last four decades. Predictions about supernovae and associated phenomena are discussed, along with supernova types and occurrence frequency. The absolute luminosities of Type-1 supernovae are considered as possible distance indicators. (IAA)

9363 ASIAGO SUPERNOVA SEARCH. Rosino, L.; Di Tullio, G. (Osservatorio Astrofisico, Asiago, Italy). Astrophys. Space Sci. Libr.; 45: 19-27(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The search for and research on supernovae performed at the Astrophysical Observatory at Asiago, Italy, since 1959 are reviewed. High galactic latitude fields kept by the observatory under surveillance (essentially, 36 in number) are listed along with the galaxies and supernovae they contain. Supernovae observed at Asiago for spectra and light curves and supernovae discovered at Asiago are also listed. (IAA)

9364 SUPERNOVA SEARCH AT ZIMMERWALD. Wild, P. (Univ., Bern). Astrophys. Space Sci. Libr.; 45: 29-32(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The supernova search performed at the observatory at Zimmerwald, Switzerland, since 1959 is summarized. Observed supernova search fields are listed, along with the 24 supernovae discovered at Zimmerwald. The search has been conducted with the aid of a 24-in. Cassegrain and a 16-in. Schmidt cameras whose developed films are examined by direct superposition in a simple binocular viewer. (IAA)

9365 PALOMAR SUPERNOVA SEARCH. Sargent, W. L. W.; Searle, L.; Kowal, C. T. (Hale Observatories, Pasadena, CA). Astrophys. Space Sci. Libr.; 45: 33-48(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The history and achievements of the Palomar supernova search are reviewed, and the methods used and programs implemented are discussed. The stellar population of supernovae is listed by order of discovery since 1885. Some of the major requirements of further research are pointed out. (IAA)

9366 EXPERIMENT TO SEARCH FOR PROMPT EMISSIONS FROM SUPERNOVAE AT MICROWAVE FREQUENCIES. Jelley, J. V. (Atomic Energy Research Establishment, Harwell, Eng.); Meikle, W. P. S.; Drever, R. W. P.; Palumbo, G. G. C.; Bonoli, F.; Smith, H.; Delaney, T. Astrophys. Space Sci. Libr.; 45: 61-71 (1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

An exploratory coincidence experiment with installations at four widely spaced stations (2 in England, 1 in Italy, and 1 in Ireland) is described that is searching for short-lived bursts of microwave radiation which may occur when supernovae erupt in clusters of galaxies of high population. Some of the preliminary results obtained are briefly reviewed. (IAA)

9367 HISTORICAL OBSERVATIONS OF SUPERNOVAE. Stephenson, F. R. (Univ. of Newcastle Upon Tyne, Eng.). Astrophys. Space Sci. Libr.; 45: 75-84(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The identification of supernova remnants with historically observed supernovae is discussed in terms of its reliability and importance for a better understanding of the processes underlying supernova physics. Following a review of early observed historical supernovae and supernovae for which a remnant has been proposed, the Crab Nebula is considered as the remnant of supernova 1054 and some remarks are presented on supernovae 185, 1006, and 1181, which are recommended to the special attention of radio astronomers. (IAA)

9368 PHOTOMETRY OF SUPERNOVAE. Arp, H. (Hale Observatories, Pasadena, CA). Astrophys. Space Sci. Libr.; 45: 89-96(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Evidence is presented, in the form of well observed Type-1 supernova light curves gathered from early work by Zwicky, Baade, and Minkowski, indicating that not all Type-1 supernovae are identical. It is shown that the most important cases are nonstandard and require special observation. (IAA)

9369 LIGHT CURVE OF TYPE I SUPERNOVAE. Barbon, R.; Ciatti, F.; Rosino, L. (Osservatorio Astrofiscio, Asiango, Italy). Astrophys. Space Sci. Libr.; 45: 99-102(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The existence of an 'average light curve' for Type-1 supernovae is investigated, along with the possibility that Type-1 supernovae form a homogeneous class whose general properties can be derived from photometric data. The results suggest the existence of two Type-1 supernova subclasses, a fast one and a slow one, which may be related to different types of stellar population in galaxies. In order to ascertain this, a greater number of well studied supernovae are needed. (IAA)

9370 PHOTOMETRY AND SPECTROSCOPY OF THE 1972 SUPERNOVA IN NGC 5253. Ardeberg, A.; De Groot, M. (European Southern Observatory, Santiago de Chile). Astrophys. Space Sci. Libr.; 45: 103-113(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Photometric and spectroscopic observations of the 1972 supernova in NGC 5253, the fourth apparently brightest extragalactic supernova ever recorded, are reviewed. The observations, performed at the European Southern Observatory in Chile, were started on May 17, 1972, (two days after this supernova's original announcement). The photometric observations are still going on, whereas the spectroscopic observations were continued until the middle of January 1973. The first night of observation was devoted to repeated high-resolution observations. These first observations were then followed up by moderately frequent reobservations. (IAA)

9371 INTERPRETATION OF THE SPECTRA OF SUPERNOVAE. Searle, L. (Hale Observatories, Pasadena, CA). Astrophys. Space Sci. Libr.; 45: 125-129(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

A review is presented of various lines of investigation of the spectra of supernovae of Types I and II. It is shown that a new view has emerged regarding the character of the supernova spectrum that is quite different from the classical one. This new view, which has now been decisively confirmed by photoelectric scanning observations, is that the spectrum of both Type I and Type II supernovae consists of a continuum modified by the superposition of broad emission and absorption lines produced in a low-temperature envelope. (IAA)

9372 OBJECTIVE PRISM SPECTRA OF SN 1972e NEAR MAXIMUM PHASE. McCarthy, M. F. Astrophys. Space Sci. Libr.; 45: 135-141(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

A review is given of observations of supernova SN 1972e (in NGC 5253) obtained with the aid of a series of objective prism plates in the spectral range from 3500 to 8800 A. The spectrum of SN 1972e as observed on these plates from the near ultraviolet to the near infrared near the time of maximum is described, and a suggestion is made regarding the possible detection of optical remnants of supernovae by means of extremely low dispersion objective prism spectra. (IAA)

9373 STATISTICS OF SUPERNOVAE. Tammann, G. A. (Hamburger Sternwarte, Hamburg). Astrophys. Space Sci. Libr.; 45: 155-184(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The supernova frequency as a function of the type and luminosity (or mass) of the parent galaxy was determined within a clearly defined sample volume. Among the topics discussed are the overall rate of supernovae; the distribution of supernovae of different types in different types of galaxies; various selection effects, including the effect of special search fields, the effect of distance, the effect of radial distribution, the inclination effect of the parent galaxy, the dependence on the luminosity of the parent galaxy, the dependence on the subtypes of Sc galaxies, the dependence on the color of the parent galaxy, and the dependence on the bar of the parent galaxy; the supernova rate per unit luminosity in different types of galaxies; the supernova rate per unit mass in different types of galaxies; the supernova in our Galaxy; and the parent population of supernovae of Types I and II. (IAA)

9374 FREQUENCY OF TYPE I AND TYPE II SUPERNOVAE. Dallaporta, N. (Osservatorio Astronomico, Padua). Astrophys. Space Sci. Libr.; 45: 187-194(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Consideration is given to the frequencies of Type I and II supernovae in relation to the populations to which they belong and to the stellar progenitors of these events. Conclusions concerning these frequencies are drawn on the basis of data collected by Tammann (1970), concerning supernovae in Sb and Sc galaxies, supplemented by information derived from other authors relating to the exact location of events in the spirals and to the relative frequencies of supernovae in ellipticals and So's with respect to spirals. An attempt is made to relate the frequencies obtained for all types of supernovae to the birthrate functions of the different stellar mass ranges in our Galaxy. (IAA)

9375 SPACE DISTRIBUTION OF SUPERNOVAE IN PARENT GALAXIES. McCarthy, M. F. (Vatican Observatory, Castel Gandolfo, Italy). Astrophys. Space Sci. Libr.; 45: 195-202(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Consideration is given to the space distribution of supernova in 148 galaxies divided into three subgroups differing with respect to their radial velocities. Frequency–distance data and density–distance data are presented for these 148 galaxies, and an analysis is made of these data with respect to supernova type and with respect to galactic type of the parent galaxy. It is concluded that supernovae can and do appear in all parts of parent galaxies and are in no way absent from the central region of parent galaxies. (IAA)

9376 NOTES ON TYPE II SUPERNOVAE. de Vaucouleurs, G. (Univ. of Texas, Austin). Astrophys. Space Sci. Libr.; 45: 203-208(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The light curves of Type II supernovae and their maximum and postmaximum luminosities are compared. The apparent and absolute magnitudes of Type II supernovae at the end of the postmaximum plateau and at the premaximum halt are reviewed, and the postmaximum plateau of the light curves is discussed as a distance indicator. (IAA)

9377 SUPERNOVAE AND EXTRAGALACTIC DISTANCES. Branch, D. (Royal Greenwich Observatory, Hertsmonceux, Eng.). Astrophys. Space Sci. Libr.; 45: 209-213(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

A review is presented of the dispersion among the absolute magnitudes of Type I supernovae at maximum light, and the mean magnitude difference between Type I and Type II supernovae is considered. It is felt that, though the possibility cannot be excluded that much of the Type I dispersion comes from an intrinsic range in rise times, a large part of the scatter is likely to be caused by distances. About the mean magnitude difference between Type I and Type II supernovae, it is felt that it may be considerably less than two magnitudes. (IAA)

9378 REMARKS ON OUTLYING SUPERNOVAE AND THE STRUCTURE OF THEIR PARENT GALAXIES. Tammann, G. A. (Hamburger Sternwarte, Hamburg). Astrophys. Space Sci. Libr.; 45: 215-220(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Consideration is given to the kind of stellar population representing the possible origin of some supernovae that have appeared at considerable radial distances outside the optical boundaries of their parent galaxies. The three typical cases covered in this preliminary report pertain to the supernovae 1909 in M 101, 19691 in NGC 1058, and 19701 in NGC 2968/70. (IAA)

9379 OPTICAL OBSERVATIONS OF SUPERNOVA REMNANTS SIMEIZ 59 AND W28. Lozenskaya, T. A. (Moscow State Univ.). Astrophys. Space Sci. Libr.; 45: 317-320(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Detailed interferometric observations of the Simeiz 59 Nebula and of a faint filamentary nebula in the central region of the nonthermal radio source W28 were performed with a high-contrast Fabry–Pérot etalon and a contact image converter set in the Cassegrainian focus of a 125-cm reflector. The radial velocities and the H alpha line half-widths were estimated at 50 to 80 points in 15 interferometric plates of the Simeiz 59 Nebula and 20 plates of the source W28. An analysis of the findings suggests that the latter is a typical Type II supernova remnant while the former might have been formed by a Type I supernova explosion in a dense interstellar gas cloud. (IAA)

9380 SUPERNOVAE AND THEIR REMNANTS. Woltjer, L. (Columbia Univ., New York). Astrophys. Space Sci. Libr.; 45: 323-327(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Some observations on the evolution of Type II supernovae are presented. Mass, mass density, ejection velocity, and temperature are mentioned in connection with supernova events viewed as spherically symmetric expansion into a uniform medium. A synopsis of electromagnetic wave phenomena and their parent magnetic fields and rotational sources is given. The inferences of radio polarization pictures are discussed, and some causes and effects of inhomogeneity are noted. (IAA)

9381 CARBON DETONATION SUPERNOVAE. Buchler, J. R. (Yeshiva Univ., New York). Astrophys. Space Sci. Libr.; 45: 329-332(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Arguments aimed at linking main-sequence stars in the mass range 4 to 8 solar masses with Type II supernovae and pulsars are presented. In this regard, the problematic evolution of the growing carbon cores before ignition is found to be best rationalized in terms of convective Urca losses. Some calculations on the parameters of carbon detonation models are listed, and the use of a standard numerical hydrodynamic code to deal with these models is discussed. (IAA)

9382 DUST ENVELOPE IN YOUNG SUPERNOVA REMNANTS. Aiello, S. (Univ., Florence); Bonetti, A.; Mencaraglia, F.; Massaro, E. Astrophys. Space Sci. Libr.; 45: 365-372(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

A semiquantitative evaluation of dust-induced uv and ir luminosity modulation in young supernovae is performed in order to verify the conclusion by Hoyle and Wickramasinghe (1970) that a significant fraction of the mass ejected from exploding supernovae may condense into solid particles during the expansion phase that follows the explosion. It is concluded that the dust envelope model associated with an expanding supernova shell, as suggested by these scientists, gives plausible results for uv and ir luminosity modulation after a supernova explosion. Present evidence from ir and soft x-ray observations of the Crab Nebula, and from visual observations of some recent supernovae in nearby galaxies, appear to lend some support to the dust envelope model. (IAA)

9383 EMISSION AND ABSORPTION LINES OF QSOs AND PROPERTIES OF THE GAS THAT PRODUCES THEM. Chan, Y. W. T. San Diego, CA; University of California (1974). 231p. University Microfilms Order No. 74-19605.

Thesis (Ph. D.).

Details of emission features of 160 QSOs are collected. Based on the available features of 220 objects, a set of average observed equivalent widths is determined for the composite QSO. (Diss. Abstr. Int., B)

9384 NEUTRAL CURRENTS AND STELLAR COOLING. Bahcall, J. N. (Institute for Advanced Study, Princeton, N. J. (USA)); Treiman, S. B.; Zee, A. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Phys. Lett., B; 52: No. 3, 275-278(14 Oct 1974).

If weak neutral currents couple with the strengths suggested by recent experiments, then stellar cooling via neutrino pair emission from thermally excited nuclear states may be significant in white dwarfs with central temperature $\leq 10^8$ °K. At higher temperatures, other neutrino cooling processes are more important. In the sun, the decay of thermally excited ^{57}Fe nuclei may produce a moderately large, but probably unobservable, low-energy flux of ν_μ, $\bar{\nu}_\mu$, ν_e, and $\bar{\nu}_e$ neutrinos. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 9367, 9380, 9382, and 10122.

9385 (UCRL-76088) REVIEW OF SOFT X-RAY ASTRONOMY. Seward, F. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Oct 1974. 23p. (CONF-740843-2). Dep. NTIS $4.25.

From international conference on x-rays in space; Calgary, Canada (14 Aug 1974).

In spite of the difficulty of soft x-ray observations, several important phenomena have been detected. The background and detector problems are now fairly well understood and the future should bring forth a large amount of high-quality data. This will greatly increase our knowledge of the structure of the Galaxy and the nature of its x-ray sources. (auth)

9386 (UCRL-76090) SUMMARY: COSMIC X-RAYS. Seward, F. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Oct 1974. 13p. (CONF-740843-3). Dep. NTIS $4.00.

From international conference on x-rays in space; Calgary, Canada (14 Aug 1974).

The contribution to x-ray astronomy of careful, accurate measurements is discussed. Although much can be said for speculative theoretical discussions, more theory firmly established by observation is needed. At this conference it has been shown how x-ray astronomy is progressing from all-sky surveys to detailed studies of specific sources. (auth)

9387 (UCRL-76111) ADAPTATION OF RECENT THERMAL MODEL CALCULATIONS TO X-RAY SPECTRA OF THREE OLD SUPERNOVA REMNANTS. Burginyon, G. A.; Hill, R. W.; Seward, F. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Oct 1974. 11p. (CONF-740843-1). Dep. NTIS $4.00.

From international conference on x-rays in space; Calgary, Canada (14 Aug 1974).

X-ray emission from three old supernova remnants, Puppis A, Cygnus Loop, and Vela X, has been observed in the energy range 0.2 to 2.5 keV. A methane-filled proportional counter was used for all of the measurements. (WDM)

9388 STABILITY OF NONRADIAL VIBRATIONAL MODES OF RELATIVISTIC NEUTRON STARS. II. Cazzola, P. (Istituto di Fisica dell'Università, Ferrara, Italy and Istituto di Fisica dell'Università, Padova, Italy); Lucaroni, L. Phys. Rev. D 10: No. 6, 2038-2040 (15 Sept 1974).

The stability of cold neutron stars with respect to nonradial oscillations which cause gravitational radiation is examined. Numerical calculations have been performed for a definite equation of state up to a central density of 10^{16} g/cm^3, for the multipoles of order $1 = 2, 3, 4, 5$. It is found that no instability occurs for such multipoles. (auth)

9389 BLACK HOLE IN A UNIFORM MAGNETIC FIELD. Wald, R.M. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 10: No. 6, 1680-1685 (15 Sept 1974).

Using the fact that a Killing vector in a vacuum spacetime serves as a vector potential for a Maxwell test field, we derive the solution for the electromagnetic field occurring when a stationary, axisymmetric black hole is placed in an originally uniform magnetic field aligned along the symmetry axis of the black hole. It is shown that a black hole in a magnetic field will selectively accrete charges until its charge becomes $Q = 2 B_0 J$, where B_0 is the strength of the magnetic field and J is the angular momentum of the black hole. As a by-product of the analysis given here, we prove that the gyromagnetic ratio of a slightly charged, stationary, axisymmetric black hole (not assumed to be Kerr) must have the value $g = 2$. (auth)

9390 STATIONARY, AXIALLY SYMMETRIC PERTURBATIONS OF CHARGED KERR BLACK HOLES. Bose, S.K.; Wang, M.Y. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. D 10: No. 6, 1675-1677 (15 Sept 1974).

It is proved that the only admissible time-independent, axially symmetric perturbations around a charged Kerr black hole are those which correspond to adding charge, mass, and angular momentum to the black hole. (auth)

9391 GEODESIC SYNCHROTRON RADIATION IN THE KERR GEOMETRY BY THE METHOD OF ASYMPTOTICALLY FACTORIZED GREEN'S FUNCTIONS. Chrzanowski, P.L.; Misner, C.W. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 10: No. 6, 1701-1721 (15 Sept 1974).

The scalar, electromagnetic, and gravitational geodesic synchrotron radiation (GSR) spectra are determined for the case of a test particle moving on a highly relativistic circular orbit about a rotating (Kerr) black hole. One finds that the spectral shape depends only weakly on the angular momentum parameter a/M of the black hole, but the total radiated power drops unexpectedly for $a/M \gtrsim 0.95$ and vanishes for $a/M \rightarrow 1$. A spin-dependent factor (involving the inner product of the polarization of a radiated quantum with the source) is isolated to explain the dependence of the spectral shape upon the spin of the radiated field. Although the scalar wave equation is solved by separation of variables, this procedure is avoided for the vector and tensor cases by postulating there a sum-over-states expansion for the Green's function similar to that found to hold in the scalar case. The terms in this sum, significant for GSR, can then be evaluated in the geometric optics approximation without requiring the use of vector or tensor spherical harmonics. (auth)

9392 CARBON MONOXIDE STUDIES OF H II REGIONS. Liszt, H. S. Princeton, NJ; Princeton Univ. (1974). 84p. University Microfilms Order No. 74-25,961.

Thesis (Ph. D.).

A survey was made of the $^{12}C^{16}O$ and $^{13}C^{16}O$ $J = 1-0$ line emission at 2.6 mm from some 25 HII regions and OH sources outside the galactic center. A new interpretation of carbon monoxide spectra is presented which indicates that collapse, rather than turbulence, is the primary source of the line profiles. From the observations the kinematics of molecule clouds are discussed and kinetic temperatures, carbon monoxide column densities, and masses for the regions surveyed are derived. (Diss. Abstr. Int., B)

9393 MODE-LOCKED MASER THEORY OF PULSARS. Mertz, L. (Observatoire de Paris, Section de Meudon, 92 (France)). Astrophys. Space Sci.; 30: No. 1, 43-55(Sep 1974).

It is proposed that pulsars are mode-locked masers rather than rotating neutron stars. The maser cavity resides at the metallic-molecular interface near the surface of ordinary cold degenerate dwarf configurations. The period distribution, including its position, width, and features, is found in good agreement with that of pulsars. Furthermore, the pulse profile morphology of pulsars and mode-locked lasers are found to be strikingly similar. Explanations are given for various other features, such as slowing down and optical pulses, and a possible connection with Jovian decametric radiation is suggested. The main shortcoming of the maser theory is that no source of energy is obvious as yet. (auth)

9394 THEORETICAL INFRARED SPECTRUM OF THE IONIZED HYDROGEN BETWEEN 0.8 AND 4.5 MICRONS. Sibille, F.; Lunel, M.; Bergeat, J. (Observatoire de Lyon, 69-Saint-Genis-Laval (France)). Astrophys. Space Sci.; 30: No. 1, 173-177(Sep 1974).

Continuous emission coefficients of the ionized hydrogen are computed, taking account of both free-free and free-bound emission, in the near infrared from 0.82μ to 4.47μ and for usual temperature in H II regions. The use of Gaunt factors of two different sources gives very close results. (auth)

9395 GAS STREAMING IN 2U0900-40 AND Cyg X-1. Wickramasinghe, D. T.; Bessell, M. S. (Australian National Univ., Canberra). Nature (London); 251: No. 5470, 25-27(6 Sep 1974).

Published photometric data on 2U0900-40 and Cyg X-1 are interpreted as evidence of gas streaming in these systems. The location and extent of the gas streams indicate that they originate from the accretion disk and extend to the far side of the primary. It is suggested that large scale mass loss is occurring from the outer regions of the accretion disk as a result of radiative acceleration by a high luminosity component of soft x rays ($\lesssim$ 1 keV), and this offers a possible interpretation of the radio observations of Cyg X-1. (auth)

9396 EFFECTS OF THERMAL PHOTON SCATTERING ON RELATIVISTIC ELECTRONS NEAR PULSARS. Tademaru, E. (Univ. of Massachusetts, Amherst); Greenstein, G. Nature (London); 251: No. 5470, 39-40(6 Sep 1974).

In this discussion it is assumed that pulsar radiation is generated close to the surface of a neutron star and that the production of this radiation involves some sort of coherent motion of relativistic electrons presumed to have been accelerated off the stellar surface by large electric fields along magnetic field lines of force. These electrons may scatter against black body photons emitted by the hot neutron star, and the hotter the star the greater the photon density and the greater the probability that the electrons will scatter against them. An examination is made of the consequences of such collisions and the conditions required for them to occur. The limit on the neutron star temperature such that scattering occurs between a thermal photon and a relativistic electron is first considered, followed by consideration of an electron accelerated by an electric field along a magnetic field line leading away from the surface of a neutron star and then decelerated by emission of synchrotron radiation. Both Thompson and Compton scattering are considered. Amongst conclusions reached are that very young neutron stars may not be pulsars, and that it is doubtful if thermal photon collisions with radiating electrons place any theoretical limits on the temperature of known pulsars. (UK)

9397 TIMING RESULTS FOR THIRTEEN PULSARS. Richards, D. W. (National Astronomy and Ionosphere Center, Arecibo, Puerto Rico); Rankin, J. M.; Zeissig, G. A. Nature (London); 251: No. 5470, 37-39(6 Sep 1974).

As part of a programme of pulsar timing measurements at the Arecibo Observatory, Puerto Rico, timing results are reported for 13 further pulsars, following a year or more of observations at 430 MHz. Some unexpected results are commented on, probably due to the pulsars exhibiting erratic behaviour. (UK)

9398 LARGE OUTBURSTS IN CYGNUS X-3. Daishido, T. (Tokyo Univ.); Kawano, N.; Kawajiri, N.; Inoue, M.; Konno, M. Nature (London); 251: No. 5470, 36-37(6 Sep 1974).

It is stated that two radio outbursts from Cyg X-3 were observed during December 1973 and January 1974. The observations were made at 4.2 GHz with the 26m. radiotelescope at the Kashima Branch of the Radio Research Laboratories, Japan. An outburst was first recognized on December 23rd, with a flux density of ~6.5 Jy, rising to a maximum of 8.30 Jy after a few hours. The second outburst was observed seven days after the first. The features of these outbursts were similar to those observed during the outbursts of Cyg X-3 in September 1972. (UK)

9399 PARTICLE ACCELERATION IN PLANETARY MAGNETOSPHERES. Houghton, M. J. (Univ. of Newcastle upon Tyne, Eng.). Nature (London); 251: No. 5472, 205-206(20 Sep 1974).

It is stated that studies of energetic particle fluxes in space have led to an interest in problems of particle acceleration inside planetary magnetospheres. Suggestions that terrestrial auroral electron precipitation may be associated with transient space charge effects have been rejected because the parallel plasma electrical conductivity is so large that magnetospheric field lines are constrained to remain equipotentials. It is pointed out, however, that planetary magnetospheric field lines are not constrained to remain equipotentials when the plasma conductivity is dominated by current driven microinstabilities as opposed to electron–ion collisions. The combination of high parallel electric potentials, due to anomalously low conductivity effects, and a tenuous but highly mobile electron component, due to the non-isotropic nature of ion–sound turbulence, provides a mechanism for the generation of sporadic and stormy outbursts of energetic electrons inside planetary magnetospheres. (UK)

9400 THE LOW–FREQUENCY SPECTRA OF COMPACT COMPONENTS IN EXTRAGALACTIC RADIO SOURCES. Harris, D.E. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts 02138). Astron. J. 79: No. 11, 1211-1219 (Nov 1974).

We report the results of interplanetary scintillation observations between 53 and 430 MHz obtained at the Arecibo Observatory. Flux densities of the small–diameter components are given for 29 sources. From the flux density of several quasars at 53 MHz, it is concluded that either the diameters of the scintillating components at 53 MHz are an order of magnitude greater than they are at 400 MHz, or the average magnetic fields in the small–diameter components are much smaller than the equipartition fields. (auth)

9401 OHIO SURVEY. VII. Rinsland, C.P.; Dixon, R.S.; Gearhart, M.R.; Kraus, J.D. (Ohio State University Radio Observatory, Columbus, Ohio 43210). Astron. J. 79: No. 11, 1129-1210 (Nov 1974).

Results are presented for the seventh installment of the Ohio survey at 1415 MHz. This installment covers 3490 deg^2 of sky between declinations of 0° and 36° S and fills large gaps in some of the previously published installments. There are 48 maps of the regions surveyed at a list of 2554 radio sources at or above 0.18 Jy. Of these sources 1850 are previously uncataloged. The seven installments include a total of about 19 000 sources in 8.6 sr of sky between 63° N and 36° S. (auth)

9402 SPECTRA OF SOURCES IN THE NRAO 5000–MHz SURVEYS. Condon, J.J. (National Radio Astronomy Observatory, Charlottesville, Virginia 22901); Jauncey, D.L. Astron. J. 79: No. 11, 1220-1231 (Nov 1974).

Spectral indices for all the NRAO 5000–MHz S–survey sources in the declination range $-2° < \delta < +39°$ were determined from 318–MHz flux densities measured at Arecibo. The spectral index distribution for 278 sources stronger than 0.6 Jy is bifurcated, showing a secondary peak near $\alpha = 0$. Both the normal–spectrum component and the fraction of flat–spectrum sources show the same changes with flux density that are found in the Pks 2700–MHz survey: the normal–spectrum sources steepen while the fraction of flat–spectrum sources decreases with decreasing flux density. The normal–spectrum source population is shown to be quite different from the ones found in low–frequency surveys in that it favors nearby galaxies with low absolute radio luminosity. Its median spectral index increases with decreasing flux density, and these sources are not distributed randomly on the sky. These effects may be due to a local ($z \lesssim 0.1$) inhomogeneity rather than cosmological causes. (auth)

9403 15.5–GHz FLUX-DENSITY MEASUREMENTS OF VARIABLE RADIO SOURCES. Dent, W.A.; Kapitzky, J.E.; Kojoian, G. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Astron. J. 79: No. 11, 1232-1241 (Nov 1974).

Measurements of flux density variation of 32 extragalactic radio sources are reported. The observations extend from 1969.0 to 1973.0 and were made with the 120–ft antenna of the NEROC Haystack Observatory. (auth)

9404 X–RAY MORPHOLOGY OF THE PERSEUS CLUSTER. Wolff, R.S.; Helava, H.; Kifune, T.; Weisskopf, M.C. (Columbia Astrophysics Laboratory, Columbia University). Astrophys. J. Lett. 193: No. 2, L53-L56 (15 Oct 1974).

A measurement of the spatial distribution of the X–ray flux of the Perseus cluster of galaxies has been made using a one–dimensional focusing X–ray collector carried aloft by a sounding rocket. Two orthogonal scans of the region were made, parallel and perpendicular to the line of galaxies joining NGC 1275 and IC 310. We observe a maximum in the flux at the location of NGC 1275 in the E–W scan and at the location of NGC 1275 and the line of galaxies in the N–S scan. The observed X–ray distribution is more extended than a point–source response, and there is considerably more broadening in the E–W than the N–S directions. Comparison of our data with previous X–ray measurements indicates that the structure of the Perseus cluster is more complex than earlier reports would indicate. (auth)

9405 STUDIES OF CLUSTER X–RAY SOURCES: SIZE MEASUREMENTS. Kellogg, E.; Murray, S. (Center for Astrophysics, Harvard College Observatory/Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 193: No. 2, L57-L60 (15 Oct 1974).

We present best–fit values of the size for nine cluster X–ray sources. The brightness (i.e., volume emissivity) function is derived from the thermal bremsstrahlung–isothermal gas sphere model for these sources, so the derived parameters are presented as core radii. New results for Abell 2256, Abell 262, and the Centaurus cluster (3U 1247–41) are given. Upper limits on the core radii for the Abell clusters 1060, 1367, 2199, 2319, and 401 and for 3C 129 are also given. Comparison with optical galaxy counts suggests that the X–ray source is two to three times larger than the galaxy distribution, on the bremsstrahlung model. We also compare our derived gas densities with those required to explain Miley's observations and the model of Jaffe and Perola for radio head–tail galaxies. We find that for the case of NGC 1265 in the Perseus cluster, the agreement is within a factor of 2. There is also good agreement for NGC 4869 in Coma and NGC 6166 in Abell 2199. The gas density required to expalin both head–tail radio galaxies and the extended X–ray sources in clusters appears to be the same for all known cases. This is a new and powerful argument for the existence of a hot intergalactic medium in clusters of galaxies. (auth)

9406 ON THE LIGHT CURVES AND MASSES OF THE X–RAY SOURCES CYGNUS X–1, SMC X–1, AND CENTAURUS X–3. Hutchings, J.B. (Dominion Astrophysical Observatory). Astrophys. J. Lett. 193: No. 2, L61-L63 (15 Oct 1974).

The light curves of the three systems are discussed. Arguments are presented against a three–body model for Cyg X–1. A significant heating effect is found to be present in SMC X–1. Differences between mass determinations of SMC X–1 are discussed. Masses of the components of Cen X–3 are found to be 17 $M_\odot$ and 0.67 $M_\odot$. (auth)

9407 UPPER LIMITS TO OPTICAL PULSATIONS FROM CENTAURUS X–3. Canizares, C.R.; McClintock, J.E. (Center for

Space Research and Department of Physics, Massachusetts Institute of Technology, Cambridge, MA 02139). Astrophys. J. Lett. 193: No. 2, L65-L66 (15 Oct 1974).

A search for optical pulsations from Cen X−3 was carried out on eight nights. No signals with power $\gtrsim 0.15-0.2$ percent were detected at the $4^{s}.8$ X−ray pulsation frequency to a 99.9 percent confidence level. Somewhat larger upper limits were obtained over a wide range of frequencies and for data collected through narrow−band filters centered at interesting optical features. (auth)

9408 METER−WAVELENGTH VLBI. I. CASSIOPEIA A. Hutton, L.K.; Clark, T.A.; Erickson, W.C.; Resch, G.M.; Vandenberg, N.R. (Astronomy Program, University of Maryland, College Park and Radio Astronomy Branch, Goddard Space Flight Center, Greenbelt, Maryland 20771); Knowles, S.H.; Youmans, A.B. Astron. J. 79: No. 11, 1248-1252 (Nov 1974).

Very−long−baseline interferometric (VLBI) observations of the supernova remnant Cassiopeia A, at 74 MHz with a 12 000−wavelength baseline and at 111 MHz with a 18 500−wavelength baseline, are reported. The fringe amplitudes are strongly varying on a time scale of about 15 to 30 minutes, which we feel can be explained by much the same complex structure as that observed at higher frequencies, plus one other compact source. Due to the poor (u,v) −plane coverage, we cannot isolate the location of the extra source unambiguously, but we can suggest possibilities. The source must lie outside the supernova remnant shell, possibly associated with a concentration of emission north of the shell, or lying outside the gap in the northeastern side of the shell. The flux and spectral index deduced for the compact source depend on the assumed size, with a range of 100 Jy and 500 Jy at 74 MHz. If the source is associated with the supernova explosion, it must have been traveling at least 5000 km sec^{-1}. (auth)

9409 DECIMETER MAPS AND RADIO SPECTRA OF S147 AND THE CYGNUS LOOP. DeNoyer, L.K. (University of Illinois Observatory, University of Illinois, Urbana, Illinois 61801). Astron. J. 79: No. 11, 1253-1258 (Nov 1974).

Radio maps of S147, at 0.2 and 0.4 GHz, are presented. Consistent choices of baselines and integration boundaries for these maps yield a spectral index of -0.67 ± 0.37 for this remnant, steeper than previously determined. A new 0.6−GHz map of the Cygnus Loop is presented, and the currently popular idea that this remnant radiates by compression of the interstellar medium is critically discussed. Finally, the frequency at which a steepening of the radio spectrum will occur for such an emission mechanism is derived in the Appendix. (auth)

9410 UHURU OBSERVATIONS OF SHORT−TIME−SCALE VARIATIONS OF THE CRAB. Forman, W.; Giacconi, R.; Jones, C.; Schreier, E.; Tananbaum, H. (Center for Astrophysics, Smithsonian Astrophysical Observatory/Harvard College Observatory). Astrophys. J. Lett. 193: No. 2, L67-L70 (15 Oct 1974).

We have analyzed Uhuru X−ray observations of the Crab and found statistically significant variability in the intensity on time scales of several tenths of a second. Our results imply either that the X−ray emission from the pulsar NP 0532 is highly variable or that we have observed a previously undetected compact source of X−rays. (auth)

9411 THE CRAB NEBULA PULSAR: RADIOFREQUENCY SPECTRAL VARIABILITY. Rankin, J.M. (Department of Physics and Astronomy, University of Iowa); Payne, R.R.; Campbell, D.B. Astrophys. J. Lett. 193: No. 2, L71-L74 (15 Oct 1974).

Flux density measurements for the Crab Nebula pulsar are given at four frequencies between 430 and 74 MHz over a 3−year period between 1971 and 1974. Intensity variations of substantial amplitude are observed at each freqeuncy. The intensities of the pulsar's three major pulse components are found to be highly correlated at 430 MHz. The fluctuations at each frequency are, however, largely independent with characteristic fluctuation times which decrease with radio frequency. (auth)

9412 RAPID OPTICAL VARIABILITY OF THE EXTRAGALACTIC RADIO SOURCE PKS 1514−24. Miller, H.R.; Clonts, S.L. (Department of Physics, Georgia State University, Atlanta, Georgia 30303); Folsom, G.H. Astron. J. 79: No. 12, 1352-1355 (Dec 1974).

Recent observations of rapid variability at optical wavelengths for PKS 1514−24 are reported. The object was observed to vary by as much as 0.5 mag in 20 min. This optical variability is more rapid than any previously reported for AP Librae. (auth)

9413 SUPERNOVAE AND SUPERNOVA REMNANTS. Proceedings of the International Conference, Lecce, Italy, May 7−11, 1973. Cosmovici, C. B. (ed.). Astrophysics and Space Science Library, Volume 45. Dordrecht, Netherlands; D. Reidel Publishing Company (1974). 405p. $37.00.

A search for radio emission from young extragalactic supernova remnants, the Palomar supernova search, and observations of the 1968 Type II supernova in NGC 5236 are among the topics covered in papers concerned with recent astronomical research in the field of supernovae and supernova remnants. Other topics covered include the interpretation of the spectra of supernovae, x-ray observations of supernova remnants by means of the Copernicus orbiting astronomical observatory spacecraft, and the magnetic field distribution in supernova remnants. Separate abstracts are prepared for 35 papers. (IAA)

For abstracts of individual papers see: 9362−9382, and 9414−9427.

9414 SEARCH FOR RADIO EMISSION FROM YOUNG EXTRAGALACTIC SUPERNOVA REMNANTS. de Bruyn, A. G. (Leiden Sterrewacht). Astrophys. Space Sci. Libr.; 45: 55-59(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The results of a search for radio emission at the sites of about 35 historical extragalactic supernovae performed with the aid of the Westerbork Synthesis Radio Telescope are reviewed. The radio emission of supernova remnants suggests the existence of a large energy reservoir in relativistic electrons and magnetic fields for whose origin no satisfactory theory has yet been proposed. Some of the difficulties of arriving at such a theory are discussed, and the targets of needed further research are pointed out. (IAA)

9415 SPECTRUM OF SN 1972e AND THE FLUORESCENCE THEORY OF SUPERNOVA LIGHT. Sartori, L. (Univ. of Nebraska, Lincoln); Chiu, B. C.; Morrison, P. Astrophys. Space Sci. Libr.; 45: 131-133(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

A theory is proposed according to which fluorescence produced by a soft x-ray burst accounts for the spectral features and redshift in a supernova after explosion. The theory implies that a helium amount equal to several tenths of the solar mass should have been ejected from the pre-supernova involved and have spread within a radius of one-to-two light years around the pre-supernova. The theory also implies that the 10124-A ir line ought to be present along with other strong He II lines in the spectrum of a supernova remnant. (IAA)

9416 OBSERVATION OF X-RAY EMISSION FROM SUPERNOVA REMNANTS. Gorenstein, P. (American Science and Engineering, Inc., Cambridge, MA). Astrophys. Space Sci. Libr.; 45: 223-242(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Recent x-ray data from supernovae are shown to give additional support to the notion that x-ray radiation results from the propagation of blast waves into the interstellar medium. The Crab Nebula, however, forms a notable exception. Synchrotron radiation is the x-ray producing mechanism in the case of the Crab Nebula. (IAA)

9417 X-RAY OBSERVATIONS OF SUPERNOVA REMNANTS BY COPERNICUS. Adams, D. J. (Univ., Leicester, Eng.); Zarnecki, J. C. Astrophys. Space Sci. Libr.; 45: 243-250(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

X-ray observations of supernova remnants obtained by means of x-ray systems carried on board the OAO-C (Copernicus) spacecraft launched in September 1972 are reviewed. The supernova remnants covered were Puppis A, IC 443, Cassiopeia A, and Cygnus Loop. The results show few similarities in the emerging x-ray structure. It seems that, in general, the x-ray diameter approximates that of the radio region. But a detailed correspondence is not found between x-ray and radio structure. (IAA)

9418 PRELIMINARY RESULTS ON THE EVOLUTION OF SUPERNOVA REMNANTS AND THEIR X-RAY SPECTRUM. Mansfield, V. N.; Salpeter, E. E. (Cornell Univ., Ithaca, NY). Astrophys. Space Sci. Libr.; 45: 251-260(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The fluid dynamic approach was used in the calculation. The results are in general agreement with the predictions of Cox (1972) and Tucker (1970, 1971). However, there are some differences in specific details. It is found that the cool, dense H I is sandwiched between two masses of gas that will radiate optically. The calculations show that supernovae remnants are capable of producing a sufficient amount of thermal x-ray energy to account for many of the observations. (IAA)

9419 SEARCH FOR CELESTIAL X-RAY BURSTS. Cline, T. L.; Desai, U. D. (Goddard Space Flight Center, Greenbelt, MD). Astrophys. Space Sci. Libr.; 45: 261-265(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Progress in two experimental programs is reported. One program involves the search through satellite data for existing evidence for fast photon intensity bursts with energies exceeding 80 keV. The second program is concerned with the development of very sensitive instrumentation to make possible studies of x-ray and gamma-ray bursts in the region from 0.1 to 15 MeV with angular resolution, energy resolution, and time resolution, taking into account the complete dynamic range from several nanoseconds to several hours. (IAA)

9420 GAMMA RAY OBSERVATIONS FROM THE CRAB NEBULA AND NP-0532. Parlier, B. (CEA, Saclay, France); Agrinier, B.; Forichon, M.; Leray, J. P.; Boella, G.; Maraschi, L.; Buccheri, R.; Robba, N. R.; Scarsi, L. Astrophys. Space Sci. Libr.; 45: 267-281(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The gamma-ray emission from the Crab Nebula and NP-0532 was investigated with a multiplate spark chamber triggered by a Cherenkov detector–scintillator coincidence system and having a detection threshold of 20 MeV. The results of six balloon flights of the instrument are presented. Data from the Crab continue to support a discrete source. NP-0532 was searched for pulsed gamma-ray emission and a temporal analysis was done on the data. The complete energy spectra of both sources are illustrated, and the pulse shape of NP-0532 is analyzed. (IAA)

9421 PHYSICAL CONDITIONS IN THE FILAMENTS OF SNR FROM THEIR OPTICAL SPECTRA: IC 443. D'Odorico, S. (Osservatorio Astrofisico, Asiago, Italy). Astrophys. Space Sci. Libr.; 45: 283-293(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Spectroscopic observations of IC 443 were carried out with the aid of an image-tube spectrograph. The observed line intensity ratios are summarized in tabular form. The data are taken as the basis of a discussion of electron density, temperature, and nitrogen and sulphur abundances. The IC 443 observations are compared with those existing for other supernova remnants. The differences in various parameters among the known remnants are greater than the differences in a single remnant. (IAA)

9422 HIGH RESOLUTION 21 cm CONTINUUM OBSERVATIONS OF SOME GALACTIC SUPERNOVA REMNANTS. Duin, R. M.; Strom, R. G.; van der Laan, H. (Leiden Sterrewacht). Astrophys. Space Sci. Libr.; 45: 295-301(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

With the Westerbork Synthesis Radio Telescope 21-cm continuum observations were made of the young and very regularly shaped remnant of Tycho. A total intensity map is given, which has a resolution of 24 × 27 sec in RA and Dec. This map looks very similar to previous results by Baldwin (1967) at the same wavelength. In addition to the total intensity, also the other Stokes parameters were mapped, and a vector representation is shown of the polarized intensity and polarization angle distribution of the 21-cm radiation. At higher frequencies the vectors lie in a circular pattern, implying a radial magnetic field, but here a typical 'cell' structure is found: regions where the position angle remains constant, while large changes define adjacent regions, the transitions being smaller than the beam studied. (IAA)

9423 SEARCH FOR GAMMA RAY LINES FROM SUPERNOVAE AND SUPERNOVA REMNANTS. Chupp, E. L.; Forrest, D. J.; Suri, A. N.; Adams, R.; Tsai, C. (Univ. of New Hampshire, Durham). Astrophys. Space Sci. Libr.; 45: 311-316(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

A gamma-ray monitor with a NaI crystal shielded with a cup-shaped CsI cover was contained in the rotating wheel compartment of the OSO-7 spacecraft for measuring the gamma-ray spectra from 0.3 to 10 MeV in search for gamma-ray lines from a possible remnant in the Gum Nebula and the apparent Type I supernovae in NGC5253. A brief analysis of data yielded no positive indications for x rays, gamma-ray lines, or continuum from these sources. (IAA)

9424 EVOLUTION OF YOUNG SUPERNOVA REMNANTS. Gull, S. F. (Cambridge Univ., Eng.). Astrophys. Space Sci. Libr.; 45: 337-341(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The shell structure and radio emission from young supernova remnants can be explained with a fluid dynamic model in which the radio emission arises in an unstable zone at the outer edge of the ejecta. The emission is maximum at a mass ratio of 0.3 and then decays due to expansion of the unstable region. It follows that neither very young or middle-aged supernova remnants should be powerful radio sources. This model predicts the physical parameters of individual remnants; for example, Cas A is the result of a larger explosion than Tycho's supernova. (IAA)

9425 MAGNETIC FIELD DISTRIBUTION IN SUPERNOVA REMNANTS. Dickel, J. R. (Univ. of Illinois, Urbana); Milne, D. K. Astrophys. Space Sci. Libr.; 45: 343-354(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

Polarimetric mapping of synchrotron emission is performed for the supernova remnants MSH14-63, MSH15-52, Puppis A, Tycho, and 3C58. Diagrams are plotted for total power isotherms, polarization E-vectors, Faraday rotation, intrinsic magnetic field directions, and distributions of fractional polarization in the sources. (IAA)

9426 DISTRIBUTION AND MOTION OF THE RELATIVISTIC ELECTRONS IN THE CRAB NEBULA. Wilson, A. S. (Leiden Sterrewacht). Astrophys. Space Sci. Libr.; 45: 355-364(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

A model is proposed to explain the structural variation of the Crab Nebula with frequency and the shape of the integrated nebular spectrum. It is argued that electrons are continuously produced near the center and move away into the nebula, losing energy by synchrotron radiation. The electrons which cause radio radiation have synchrotron half lives of above 1000 years and can move to the edge without losing much energy. Thus there are no variations of spectral index at radio frequencies. At some frequency lower than that of optical radiation, the half lives of the electrons become equal to the diffusion times to the edge. Above this frequency the size of the source decreases with increasing frequency, and the spectral index of the integrated emission is then steeper due to equilibration between electron injection and synchrotron energy loss. (IAA)

9427 FORMATION OF WISPS IN THE CRAB NEBULA. Ferrari, A. (Univ., Turin). Astrophys. Space Sci. Libr.; 45: 375-379(1974).

From conference on supernovae and supernova remnants; Lecce, Italy (7 May 1973).

The physical nature of 'wisps', interior microfeatures of the Crab Nebula first observed in 1921, is discussed. Attention is given to the energetic correlation between the young pulsar NP0532 and the Nebula as the originator of the wisps. An analysis of a physical model of the pulsar leads to the conclusion that the wisps can be plasma condensations generated by a turbulent relativistic wind which is emitted by the pulsar during the interaction with electromagnetic waves. (IAA)

9428 MEASUREMENT OF THE POSITIONS OF X-RAY SOURCES. Willmore, A. P. (Univ. of Birmingham, Eng.). Proc. Roy. Soc. (London), Ser. A.; 340: No. 1623, 439-446(8 Oct 1974).

A method of measuring the positions of x-ray sources with Copernicus is described. The limitation of the accuracy achievable for bright sources is set by the uncertainty in the experiment pointing direction which is about ±0.5′, while for faint sources an additional contribution to the error of a similar magnitude arises from statistical fluctuations in the counting rates. The positions of a number of sources have been successfully measured. In addition, bright stars proposed as optical counterparts for a further four sources have been examined. Three of these associations are disproved, the results for the fourth being inconclusive. The proposed association of sources in the 2U catalogue with bright stars is found to be unlikely, the number of coincidences having been reduced by these and other observations to the level expected from random fluctuations. (auth)

9429 COSMIC MASERS. Strel'nitskii, V. S. Usp. Fiz. Nauk; 113: No. 3, 463-502(Jul 1974). (In Russian).

The article deals with one of the most urgent problems of contemporary astrophysics—explaining the nature of "anomalous" cosmic radiation in radio lines of OH and H_2O, and is a review of observational material and theoretical studies in this field up to 1973 inclusively. The main features of the radio emission of OH and H_2O are interpreted by starting from the concept of a natural cosmic maser, which is generally accepted. Basic relations are derived describing the process of amplifying the traveling wave in the cosmic wave. A detailed discussion is presented on the most realistic of the proposed models for pumping up the inverse level population. Significant attention is devoted to possible manifestations of nonlinear effects and to the reasons for the observed nonstationarity of the radiation. Detailed consideration is given to the cosmogeny aspect of the problem—arguments are presented in favor of the "youth" of maser sources and their relation with regions of star- and planet-formation. 1 table. 10 illustrations. 148 references. (JSR)

9430 STUDIES OF THE X-RAY EMISSION FROM SUPERNOVA REMNANTS. Culhane, J. L. (Mullard Space Science Lab., Dorking, Eng.). Proc. Roy. Soc. (London), Ser. A; 340: No. 1623, 423-437(8 Oct 1974).

Supernova remnants are now recognized as a class of soft x-ray emitting-objects. The evolution of a remnant's x-ray emission is discussed and a number of possible x-ray emission mechanisms are described. The spectrum of the Crab Nebula has been studied with Copernicus. The data have been used to derive a value of the gas column density of the interstellar medium. The x-ray structure and spectrum of the remnant Cassiopeia A have been investigated and the results are presented. A high resolution x-ray map of the Puppis A supernova remnant has been obtained and the interpretation of the x-ray structure is discussed. X-ray emission has been detected from the pulsar PSR 08 33-45. This observation is compared with the data obtained from the Uhuru satellite in order to derive the gas column density to the source. Weak soft x-ray emission has been detected from the Cygnus Loop in the regions expected but at a lower intensity—a search for regions of higher intensity is continuing. A program to identify known radio remnants as x-ray emitters is in progress and the results obtained so far are reported. (auth)

Solar Phenomena

Refer also to abstracts 9324, 9384, 9509, and 9551.

9431 (AD-779013) RELATIVE INTENSITIES OF THE LYMAN LINES OF HYDROGEN-LIKE OXYGEN, MAGNESIUM, AND SILICON IN THE SOLAR CORONA. Report for September 1973–February 1974. Rugge, H. R.; Walker, A. B. C. Jr. (Aerospace Corp., El Segundo, Calif. (USA)). 30 Apr 1974. Contract F04701-73-C-0074. 24p. (SAMSO-TR-74-103). NTIS $3.00.

Observations of the relative intensities of the Lyman lines of hydrogen-like O VIII, Mg XII, and Si XIV in the solar corona were made by satellite-based x-ray crystal spectrometers and are reported. A comparison between the experimentally observed values of the intensity ratio of the Lyman alpha to the Lyman beta line (Lyman ratio) was made with the recent theoretical predictions of this ratio by Hutcheon and McWhirter for low density plasmas. Good agreement is found between the theory and observations for those times for which a valid coronal temperature model was derived and applied to the temperature-dependent theoretical ratio. Observations made at times of greater solar activity appear to be inconsistent with the theory. (auth)

9432 (AD-779249) HIGH RESOLUTION SOLAR SPECTRA. Final Scientific Report, 16 December 1971–15 December 1973. Migeotte, M. V. (Liege Univ. (Belgium). Inst. d'Astrophysique). 15 Mar 1974. 11p. (AFCRL-TR-73-0593). NTIS $4.00.

Investigations being undertaken on high resolution solar spectra obtained at the Jungfraujoch and high resolution solar spectra obtained by balloon are described. (auth)

9433 (AD-779259) PICTORIAL REVIEW OF OSO 7 WHITE LIGHT CORONAGRAMS AND EXTREME ULTRAVIOLET HELIOGRAMS. Seal, R. T.; Roberts, D. E.; Whitney, J. D. (Naval Research Lab., Washington, D. C. (USA)). 11 Apr 1974. 17p. (NRL-A-01-34). NTIS $3.00.

Since September 29, 1971, two NRL experiment instruments aboard orbiting solar observatory (OSO 7) have been receiving daily images of the solar disk in the far ultraviolet, which is invisible from the ground, and of the white light solar corona, which is seen only during eclipses. A brief description is given of the instruments, and a series of daily pictures are shown covering one solar rotation. Besides daily changes, the series shows examples of other newly observed phenomena, such as close passage of the planet Jupiter and the moon ultraviolet coronal holes, and a transient coronal event. (auth)

9434 (AD-779498) PARTICLE FLUXES ASSOCIATED WITH SOLAR FLARES. Final Report. Waltner, A. W.; Oliver, G. J. (North Carolina State Univ., Raleigh (USA). Dept. of Physics). May 1974. Contract DAAD05-69-C-0294. 174p. (BRL-CR-151). NTIS $5.00.

An investigation of particle fluxes associated with solar flares was carried out with rocket-borne instrumentation. Two instruments were flown on each of six Nike Javelin rockets from Ft. Churchill, Canada subsequent to the onset of the PCA event of November 1969. The first instrument consisted of a three-counter telescope detecting electrons, protons, alphas, and gamma rays. Data were obtained at altitudes of about 40 to 130 kilometers with seven logic outputs representing various energy intervals for electrons, protons, alpha particles, and gamma rays. Flux variations with time are observed over a period of about 50 hours and are compared with available satellite data. The second instrument contained a silicon avalanche detector designed for low energy electrons. A magnetic field is cyclically applied to separate low energy electrons from high energy particulate or photon radiation. From this instrument is obtained the count rate and spectral data for low energy electrons. Comparisons of four separate launches are made to demonstrate the flux variation over a period of several days. (Modified author abstract)

9435 (AD-782710) MILLIMETER WAVE SOLAR OBSERVATIONS. Castelli, J. P.; Guidice, D. A.; Kalaghan, P. M. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 12 Jul 1974. 4p. (AFCRL-TR-74-0308). NTIS $4.00.

Several categories of millimeter wave observations in the range approximately 20 and 3 mm are considered. First, the general area of current observations conducted with small antennas of low resolving power and simple radiometric receivers is reviewed. The type of solar information derived and its application are discussed. The second area considered is that of current high-resolution solar investigations from antennas with beam widths as small as 1 minute of arc. Finally, future ultra-high resolution work (<10 arc seconds) by interferometer techniques and the need for such work are discussed. (auth)

9436 OBSERVATION OF RADIO WAVE STAR SCINTILLATION. Kakinuma, T.; Watanage, T.; Washimi, H.; Kojima, M. (Nagoya Univ., Japan). pp 138-147 of International Magnetosphere Study Symposium. Tokyo; Tokyo Univ. (1973). (In Japanese)

From symposium on international magnetosphere study; Tokyo, Japan (21 Jun 1973).

A new antenna for observation of radio stars was designed. The observation of high-frequency scintillation is necessary to investigate the vicinity of the Sun. The antenna is a cylindrical parabolic antenna, and its size is 90 m in east–west direction, and 20 m in south–north direction. The observable frequency is up to 500 MHz. The purposes of the project are studies on the structure of semisteady solar fast particle flow, the interplanetary space disturbance associated with flares, the three-dimensional structure of the solar wind, and plasma phenomena in solar wind. It is possible by the multipoint observation of radio star scintillation to obtain the three-dimensional structure, such as the velocity of solar wind, the turbulence of electron density and so on. The results of observation of the sources 3C144, 3C273, 3C48, and 3C298 are reported. It was found from the observation of low-latitude zone with 3C144 and 3C273 that the direction of the flow of solar wind was in agreement with radial direction. The observation from low to medium latitude with 3C48 and 3C298 showed that the direction of the flow deviated from radial direction. The observation from medium to high latitude with 3C48 indicated that the direction of the flow deviated from ecliptic surface on the east side of the Sun, and directed to the ecliptic surface on the west side. (JA)

9437 LUMINESCENCE IN INTERPLANETARY SPACE. Observation of False Zodiacal Light. Tanabe, H. (Tokyo Univ.). pp 108-112 of International Magnetosphere Study Symposium. Tokyo; Tokyo Univ. (1973). (In Japanese)

From symposium on international magnetosphere study; Tokyo, Japan (21 Jun 1973).

False zodiacal light is introduced in this paper, and examples are explained. This phenomena was observed by Fesenkov on Oct. 8, 1946, when he made the observation of counterglow at Sary-Ishik-Otrau Desert in Central Asia. Divari noticed the same phenomena on Oct. 25, 1946 at Grnaya Astrophysical Observatory near Alma Ata. The author took successful photographs in March, 1972 at Ogasawara Island, where he had noticed the phenomenon in Oct. 1971. Bright east sky in the evening and west sky at peep of dawn were observed. Bousfield reported similar phenomena observed during the period from 1931 to 1933, and named them as "Western Cone". In 1952, Hoffmeister reported the false zodiacal light in east sky in the evening also, while Fesenkov reported that the light can be seen only in west sky. Photoelectric observation of the phenomena was carried out by Weinberg from 1961 to 1962. Since the data is still scarce, it is hard to come to any conclusion on the property of the zodiacal light. An observational program is still in progress. (JA)

9438 PROJECT OF OBSERVATION OF SOLAR PHENOMENA. Nishi, K. (Tokyo Univ.). pp 165-168 of International Magnetosphere Study Symposium. Tokyo; Tokyo Univ. (1973). (In Japanese)

From symposium on international magnetosphere study; Tokyo, Japan (21 Jun 1973).

Present and future projects for the observation of solar phenomena are described. Sunspots, flares, prominences, corona lines, etc. were observed at Tokyo Observatory and Mt. Norikura.

The Hα lines of the flare was reported in IQSY Report on Solar Phenomena. The apparatus used was a spectroheliloscope, which is illustrated. This apparatus can measure the variation of the outline of the Hα lines with high time resolution, and motion density and temperature of active region are quantitatively obtained. The improvement of resolution and luminosity was made on this apparatus. The recording system was also improved. It is considered to attach a Fabry–Pérot interferometer to observe the position and motion of a flare precisely. The observation of the spectra of flares and the tracing of the time-variation of spectral lines were also carried out at the time of IQSY. A telescope for the observation of solar phenomena at Okayama Observatory is a powerful tool for the study on solar phenomena because of its dispersion. It is planned to observe continuously the monochromatic image of the Sun with the combination of a TV camera and narrow band filters for the Hα line of hydrogen and the K line of calcium. (JA)

9439 RASPROSTRANENIE RADIOVOLN V SOLNECHNOI SISTEME. (Propagation of Radio Waves in the Solar System). Iakovlev, O. I. Moscow; Izdatel'stvo Sovetskoe Radio (1974). 192p.

The theory of radio wave propagation through planetary atmospheres, in the near solar region, and through the interplanetary medium is studied in three parts. First, techniques for analyzing radio wave scattering experiments are described. These experiments have investigated the surfaces of the Moon, Venus, and Mars. In the second part, the propagation of radio waves in the atmospheres of Mars, Venus, and Jupiter is studied. In these experiments, the transmitting device can either be located on surface of the planet or be flying near the surface, as in occultation experiments. Finally, the propagation of radio waves in the interplanetary and near solar plasma is investigated, including a study of the effect of the Sun's gravitational field on electromagnetic radiation propagating near the Sun. (IAA)

9440 PROJECT OF HELIOMAGNETOGRAPH. Nishi, K.; Makita, M. (Tokyo Univ.). pp 169-174 of International Magnetosphere Study Symposium. Tokyo; Tokyo Univ. (1973). (In Japanese)

From symposium on international magnetosphere study; Tokyo, Japan (21 Jun 1973).

Study of solar magnetic fields and velocity fields will give various information on solar phenomena and on the magnetic field in interplanetary space. Observation of these phenomena has been done with magnetographs since 1950. The principle of the magnetographs is to measure the polarization of spectral lines due to the Zeeman effect. Evans evaluated the polarization of the 5250 Å absorption line of iron. The present telescope for the observation of the Sun installed at Okayama Observatory is a coelostat type telescope. This type of telescope cannot avoid the polarization due to the reflection of light by mirror. Incidence angle varies momentarily. The polarization due to reflection depends on incidence angle and affects the results of observation. Two photoelectric tubes are arranged to compensate linear polarization. A new magnetograph is proposed, which has two polarization compensation apparatuses and a polarization analyzer. The polarization due to reflection is compensated by additional mirrors, and the degree of polarization due to the apparatus itself will be reduced to 10^{-5}. The analysis of polarization is performed by rotating a ¼ wavelength plate. A Wollaston prism is used instead of a polaroid. Observed results are stored in magnetic tapes of a memory unit of the analyzer. (JA)

9441 DYNAMIC MODEL OF SOLAR CORONAL SPICULES. Sahai, S. K. Laramie, WY; Univ. of Wyoming (1974). 107p. University Microfilms Order No. 74-23,703.

Thesis (Ph.D.).

The hydrodynamic equations for an ideal, inviscid hydrogen gas in a gravitational field are solved by an explicit Lax–Wendroff one-step technique using two-dimensional cylindrical coordinates assuming azimuthal symmetry. The height and the radius of the cylinder are taken to be 7800 km and 3800 km respectively. The base of the cylinder lies approximately 3800 km below the chromosphere–corona transition region. The temperature profile below the transition region is taken from the radio data while the profile above it is calculated on the assumption of constant downward thermal flux. The temperatures at the base and the top of the cylinder are therefore 10000°K and 1.021×10^6°K respectively. Thermal conduction, radiation, and magnetic field are taken into consideration. Magnetic field is not included as such but its effect on the thermal conductivity is taken into account. Two sets of calculations are performed: one assuming that the field lines converge 400 km, and one 1200 km below the transition region. The calculations show that in the absence of magnetic field (vertical thermal conduction only) the atmosphere is stable. No radial motions are observed. Introduction of the magnetic field produces radial as well as vertical velocities. Spicule-like features are evident in a two-dimensional vector velocity plot. The density of such features is 2 to 3 times the density of the surroundings. (Diss. Abstr. Int., B)

9442 PHOTOELECTRIC SOLAR LIMB SCANS FOR DETERMINING MEAN CHROMOSPHERIC STRUCTURE. Barnhart, P. E. Columbus, OH; Ohio State Univ. (1974). 213p. University Microfilms Order No. 74-24,296.

Thesis (Ph. D.).

An observational technique first described by Mohler is adapted to observe the intensity distribution across any limb of the Sun simultaneously in two wave lengths. By selecting one wave length in the core of a strong chromospheric line and the other in a nearby portion of the continuum it is possible to obtain spacially coherent intensity profiles. The separation of the inflection points, or limbs of the two scans is found to be largely independent of the seeing. It is thus a reliable indicator of at least one average characteristic of the chromospheric structure—the height above the photosphere at which the chromospheric material apparently becomes opaque. This height seems to show little latitude dependence for the Balmer lines, the H- and K-lines of Ca II and the Na D-lines. However, lines of He I show rather striking variations in intensity and extent above the limb at different latitudes. Analysis of seeing dependent parameters indicates the technique might prove useful in monitoring local seeing conditions. It also makes possible a simple on-line focus control for solar imaging systems. There is some evidence of slight limb brightening for H_α and the Ca II H- and K-lines. There is also evidence that He I λ6687 may be observed in absorption at the extreme photospheric limb. The method yields intensity scale heights considerably larger than obtained from eclipse observations. Scale heights measured in this investigation do not seem to be unduly affected by seeing and are consistent with maximum heights to which emission is detectable. These maximum heights correlate well with those obtained from flash spectrum analysis except in the case of the Na D-lines which are found in this investigation to extend higher by a factor four. The chromospheric limb exhibits a slope not too different from that of the photospheric limb. At times of best seeing the two limbs do not differ in slope by as much as a factor two. (Diss. Abstr. Int., B)

9443 MAGNETIC FIELDS IN THE SUN. Mullan, D. J. (Franklin Inst., Swarthmore, PA). J. Franklin Inst.; 298: No. 4, 341-362(Oct 1974).

The observed properties of solar magnetic fields are reviewed, with particular reference to the complexities imposed on the field by motions of the highly conducting gas. Turbulent interactions between gas and field lead to heating or cooling of the gas according as the field energy density is less or greater than the maximum kinetic energy density in the convection zone. The field strength above which cooling sets in is 700 G. A weak solar dipole field may be primeval, but dynamo action is also important in generating new flux. The dynamo is probably not confined to the convection zone, but extends throughout most of the volume of the sun. Planetary tides appear to play a role in driving the dynamo. (auth)

9444 ON THE LIMITATIONS OF GEOMAGNETIC MEASURES OF INTERPLANETARY MAGNETIC POLARITY. Russell, C. T.; Rosenberg, R. L. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics). Solar Phys.; 37: No. 1, 251-256(Jul 1974).

The maximum attainable accuracy in inferring the interplanetary magnetic polarity from polar-cap magnetograms is about 88%. This is achieved in practice when high-latitude polar-cap stations are used during local summer-months, and the signature in the ground records is strong. An attempt by Svalgaard (1972) to use this effect to infer an index of interplanetary magnetic polarity back to 1926 has not been so successful. Furthermore, some of the properties of the index have changed with time. Prior to 1963, the inferred polarities are strongly dependent on geomagnetic activity, while after this time they are not. Thus, this index should not be used to separate solar magnetic from solar-activity effects prior to 1963. (auth)

9445 YEARLY VARIATION IN THE SYNODIC ROTATION PERIOD OF THE SUN. Research Note. Graf, W. (Stanford Univ., Calif. (USA). Radio Astronomy Inst.). Solar Phys.; 37: No. 1, 257-260(Jul 1974).

During the course of the year, the apparent rotation period of the Sun, as observed from the Earth, changes because the speed of Earth in orbit varies. This paper derives a formula to compute the synodic period of the Sun for any day of the year. (NL)

9446 THE ULTRAVIOLET SOLAR SPECTRUM 2756Å-2831Å. Greve, A. (Max-Planck-Institut fuer Radioastronomie, Bonn

(F. R. Germany)); McKeith, C. D. (Queen's Univ., Belfast, Northern Ireland (UK). Dept. of Physics). Solar Phys.; 37: No. 1, 3-30(Jul 1974).

The ultraviolet spectrum of the Sun over the region 2756 Å to 2813 Å has been observed with a spectral resolution of 0.016 Å during the rocket flight of an interferometer spectrograph. Reduced wavelengths and identifications are presented together with a spectral atlas of the recorded region. (auth)

9447 OBSERVATIONS OF RESONANCE POLARIZATION IN Ca I_λ 4227. Stenflo, J. O. (Lund Observatory, Lund, Sweden). Solar Phys.; 37: No. 1, 31-42(Jul 1974).

The resonance polarization in Ca I_λ 4226.73 has been measured close to the solar limb for three values of $\mu = \cos\theta$. The polarization has maxima in the wings at about −500 and +400 mÅ from the line center, the plane of polarization (electric vector) being parallel to the solar limb. The blue wing is more polarized than the red wing, contrary to earlier results of Bruckner (1963). Local minima in the polarization curves occur at the position of blends. The polarization in the wings increases rapidly with decreasing μ. At $\mu = 0.15$ the maximum polarization in the blue wing is about 2.4%. The observations are in good qualitative agreement with the recent theory of Dumont et al. (1973), but the observed polarization degrees are significantly smaller than the computed values. This may be explained by the inadequate formula for van der Waals broadening used in the theoretical calculations. Much of the discrepancies between observed and computed values disappear if the recent value of Lites (1974) for the collisional damping constant is used. Further improvements in theory and observation are discussed. (auth)

9448 ON THE AVERAGE OPTICAL DEPTH OF FORMATION OF WEAK FRAUNHOFER LINES. Gurtovenko, E.; Ratnikova, V. (AN Ukrainskoj SSR, Kiev); de Jager, C. (Astronomical Institute, Utrecht, The Netherlands). Solar Phys.; 37: No. 1, 43-52(Jul 1974).

Methods for the determination of the average optical depth of formation of weak Fraunhofer lines are compared, and their relative merits are discussed. Distinction should be made between the region of origin of the emergent radiation, and of the line depression. For weak or fairly weak lines the average optical depth of formation of the line depression is the relevant quantity; it should be determined by using a computational scheme based on the classical weighting functions of line formation; other methods give physically insignificant or conflicting results. (auth)

9449 RESPONSE OF AN OPTICALLY THIN, ISOTHERMAL ATMOSPHERE TO A CONVECTIVE OVERSHOOT. Chen, C. J. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Solar Phys.; 37: No. 1, 53-62(Jul 1974).

Radiation is believed to be hostile to the generation of gravity waves by granulation at the base of photosphere where the radiation is effective. A convective overshoot from subphotosphere seems able to penetrate to a height where the solar temperature is minimum and to excite the gravity waves in a stable region there. The response of the solar atmosphere to a Gaussian disturbance characterizing such a convective overshoot is studied in an unbounded isothermal atmosphere. Radiative effects are included, but only in regions which are optically thin. The response is measured in terms of mean vertical kinetic energy density (E_z) and mean vertical external energy flux (Q_z). E_z and Q_z were calculated for a wide range of frequencies centered at the observed 5-min velocity oscillation period. The computed sharp and broad power spectra at the lower chromosphere and the upper photosphere, respectively, are attributed to the combined effects of space damping and source function. Low-frequency waves (2000 s or longer) are found to be not responsible for depositing energy in the upper solar atmosphere. (auth)

9450 THE CENTER-TO-LIMB VARIATION OF THE PHOTOSPHERIC WAVE SPECTRUM. Stix, M.; Woehl, H. (Goettingen Univ. (F. R. Germany)). Solar Phys.; 37: No. 1, 63-74(Jul 1974).

Using photoelectric observations in the Fe 5576 Å line line-of-sight velocities were obtained at nine different positions on the solar disk, as functions of one horizontal coordinate and time. With the help of the Fast Fourier Transform algorithm, two-dimensional power spectra (horizontal wave number and frequency) were calculated. Special attention was given to the possible existence of horizontal sound waves. Only very little power is found in these waves; thus the excitation of the solar atmosphere to oscillations by locally overshooting granules, which should be accompanied by horizontal sound waves with large amplitudes, can play only a minor role. (auth)

9451 HIGH RESOLUTION SPECTROSCOPY OF THE DISK CHROMOSPHERE. IV. Evidence for the Propagation and Dissipation of Mechanical Energy in the Chromosphere. Cram, L. E. (Sydney Univ. (Australia). Dept. of Applied Mathematics). Solar Phys.; 37: No. 1, 75-83(Jul 1974).

Time-series observations of small-scale Ca II emission features located outside the network in the quiet chromosphere are described. Simultaneous spectra in K and λ8542 show unambiguously that the evolutionary behaviour of the K-line profile due to an outwardly propagating velocity pulse. Assuming that this pulse is a progressive acoustic wave, as suggested by the inferred flow parameters, it is shown that the wave loses mechanical energy in traversing the chromosphere. This implies that the bright Ca II features (K- grains) are the manifestation of local heating in the chromosphere, possibly by shock waves. (auth)

9452 PROPERTIES OF THE SOLAR Ca II K-LINE AT HIGH SPATIAL RESOLUTION. Grossmann-Doerth, U.; Kneer, F.; von Uexkuell, M. (Fraunhofer Institut, Freiburg, F. R. Germany). Solar Phys.; 37: No. 1, 85-97(Jul 1974).

The analysis of three Ca II K-spectra with spatial resolution of ~ 1″ is described and its results presented. The comparison of the observed single peak line profiles with model computation leads to some conclusions regarding the nonuniform large-scale velocity fields in the chromosphere. (auth)

9453 STRUCTURE OF SUNSPOTS. II. A Continuum Model Atmosphere for Dark Umbral Cores. Zwaan, C. (Astronomical Institute, Utrecht, The Netherlands). Solar Phys.; 37: No. 1, 99-111(Jul 1974).

The sunspot models published so far do not reproduce the observed run of the umbral continuum intensities over the entire spectral range $0.5 < \lambda < 4\ \mu$m. Moreover, in several previous models the temperature gradient is smaller than both the adiabatic and the radiative equilibrium gradient. Agreement between intensities computed from accepted models and measured intensities can be obtained by introducing an additional opacity for $\lambda \lesssim 0.8\ \mu$m, which is probably caused by the crowding of atomic and molecular lines. A new umbral model atmosphere is presented with a wavelength dependent opacity enhancement factor which explains the continuum intensities and also reproduces plausible center-to-limb variations and line profiles. This model is in radiative equilibrium down to $\tau_{0.5} = 1.5$, with an effective temperature of 4000 ± 100K. For the deeper superadiabatic layers a small but probably significant departure from radiative equilibrium is indicated by the intensities in the range $1.5 < \lambda < 2.4\ \mu$m. The uncertainties in the present model and the effect of the additional opacity on line profiles are briefly discussed. (auth)

9454 THE CROSSOVER EFFECT IN SUNSPOTS AND THE FINE STRUCTURE OF PENUMBRA. Golovko, A. A. (AN SSSR, Irkutsk. Sibirskij Inst. Zemnogo Magnetizma Ionosfery i Rasprostraneniya Radiovoln). Solar Phys.; 37: No. 1, 113-125(Jul 1974).

The peculiarities of magnetosensitive lines in the penumbral spectrum and the abnormal distribution of circular polarization in them are explained satisfactorily in terms of superposition of radiation originating in different elements of penumbral fine structure. Complicated asymmetric rv-contours can be represented as a sum of two components related to bright (BR) and dark (DR) penumbral regions. Crossover effect in sunspot penumbra appears, when there is considerable relative radial mass velocity in BR and DR, having the magnetic field of different polarities in them. Such conditions are supposed to exist in the penumbra of some sunspots, situated close to the solar limb. (auth)

9455 THE NATURE OF THE SUNSPOT PHENOMENON. II. Internal Overstable Modes. Parker, E. N. (Chicago Univ., Ill. (USA). Dept. of Physics). Solar Phys.; 37: No. 1, 127-144(Jul 1974).

The properties of Alfvén waves in a vertical column of field are pointed out as a guide in treating the complicated problem of overstability. There are internal Alfvén waves of arbitrary form propagating along the magnetic field, without disturbing the fluid outside the column. There are also surface waves which involve the fluid both inside and outside the column of field. The surface waves propagate at a speed less than the Alfvén speed. Convective forces couple the internal and external fluid motions. If the forces are not too strong, the identity of the modes, as internal waves or surface waves, is maintained. The surface waves are unstable and may contribute to some of the activity of a sunspot. It is suggested that the internal Alfvén wave modes are of more central interest for producing the basic sunspot phenomena. They represent the degenerate case, and their form is worked out in some detail. The overstable Alfvén wave modes peak sharply near the outer edge of the field, and do not strongly disturb the fluid outside. This effect may contribute to the sharp edge of the sunspot umbra. Recent observations by Giovanelli show intense wave activity originating inside the edge of the umbra. The activity is tentatively identified with the peak in the overstable modes within the umbra. (auth)

9456 A FACULAR MODEL BASED ON THE WINGS OF THE Ca II LINES. Shine, R. A.; Linsby, J. L. (Colorado Univ., Boulder (USA)). Solar Phys.; 37: No. 1, 145-150(Jul 1974).

A relatively simple procedure is developed for deriving models of upper photospheric regions based on the damping wings of the Ca II resonance and infrared triplet lines. The procedure is used to derive a facular model but can also be applied to late-type stars. The model is compared to that of Chapman. (auth)

9457 TIME-AVERAGED OBSERVATIONS OF THE SUN WITH A 3840Å FILTER. Chapman, G. A. (Aerospace Corp., Los Angeles, Calif. (USA)). Solar Phys.; 37: No. 1, 151-155(Jul 1974).

Observations of the Sun with a 3840 Å interference filter of 12 Å full-width at half-maximum are compared with broad band filtergrams at 5300 Å and 6103 Å magnetograms. The limit for detecting faculae by the three techniques is compared. An improvement in detecting faculae at 3840 Å can be obtained by time-averaged photographs with the time-averaging done either at the telescope or in the darkroom. The former method has certain disadvantages. The 3840 Å filter can show the presence of faculae near the limb much better than white-light photographs or magnetograms. This feature makes 3840 Å filtergrams useful in conjunction with solar oblateness studies. (auth)

9458 A MODEL COMBINING THE POLAR AND THE SECTOR STRUCTURED SOLAR MAGNETIC FIELDS. Svalgaard, L.; Wilcox, J. M.; Duvall, T. L. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Solar Phys.; 37: No. 1, 157-172(Jul 1974).

A phenomenological model of the interplay between the polar magnetic fields of the Sun and the solar sector structure is discussed. Current sheets separate regions of opposite polarity and mark the sector boundaries in the corona. The sheets are visible as helmet streamers. The solar sector boundary is tilted with respect to central meridian, and boundaries with opposite polarity change are oppositely tilted. The tilt of a given type of boundary (+, –) or (–, +) changes systematically during the sunspot cycle as the polarity of the polar fields reverses. Similar reversals of the position of the streamers at the limbs takes place. Considering (a) a sunspot cycle where the northern polar field is inward (–) during the early part of the cycle and (b) a (+, –) sector boundary at central meridian, the model predicts the following pattern: a streamer at high northern latitudes should be observed over the west limb together with a corresponding southern streamer over the east limb. The current sheet runs now NW–SE. At sunspot maximum the boundary is more in the N–S direction; later when the polar fields have completed their reversal the boundary runs NE–SW and the northern streamer should be observed over the east limb and the southern streamer over the west limb. Observational evidence in support of the model is presented, especially the findings of Hansen, Sawyer and Hansen, and Koomen and Howard that the K-corona is highly structured and related to the solar sector structure. (auth)

9459 TABLES FOR DETERMINING THE CONCENTRATION OF ATOMS IN A GIVEN STATE: INTERESTING CORONAL IONS. Rozelot, J. P.; Noens, J. C.; Pech, B. (Observatoire du Pic du Midi, 65–Bagneres-de-Bigorre (France)). Solar Phys.; 37: No. 1, 173-178(Jul 1974). (In French).

The populations of the excited levels of coronal ions follow with very great accuracy an analytical law of the type $a \times N_e^b$, where N_e is the electron density of the medium and where a and b are only temperature and solar limb distance dependent coefficients. This form is particularly well adapted for the interpretation of the intensity measurements of coronal emission lines. The coefficients a and b here presented have been determined according to the results of various authors, and deal with the levels concerning the transitions responsible for the lines observed in the visible and infrared coronal field, and chiefly bear on the following ions: Fe X, XI, XIII, XIV, XV; Ca XIII, XV; Ni XII, XIII, XV, XVI, and Ar XIV. The most sensitive lines to the electron density can be selected thanks to the examination of the coefficient b. (auth)

9460 PREDICTION AND IDENTIFICATION OF SOME FORBIDDEN LINES IN THE Ne I SEQUENCE. Research Note. Kastner, S. O. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Solar Phys.; 37: No. 1, 179-181(Jul 1974).

The values of the $2p^5 3s$ ($^3P_1 - ^3P_2$) interval and the $2p^5 3s - 2p^6$ wavelengths are given for the higher ions of the Ne I sequence. The former are then plotted against atomic number and compared with calculated values. (NL)

9461 TWO-FLUID MODEL OF THE SOLAR CORONA. Knight, J. W.; Newman, C. E.; Sturrock, P. A. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Solar Phys.; 37: No. 1, 183-187(Jul 1974).

A simple model of the lower corona which allows for a possible difference in the electron and proton temperatures is analyzed. With the introduction of a phenomenological heating term, temperature and density profiles are calculated for several different cases. It is found that, under certain circumstances, the electron and proton temperatures may differ significantly. (auth)

9462 SHORT DURATION SOLAR MICROWAVE BURSTS AND ASSOCIATED SOFT X-RAY EMISSION . Spangler, S. R.; Shawhan, S. D. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Solar Phys.; 37: No. 1, 189-203(Jul 1974).

During the time period of November 1968 to March 1970, 259 15.4 GHz impulsive microwave bursts have been identified of which 147 had associated 2 to 12 Å soft x-ray bursts. Average durations, rise times, and decay times for the microwave bursts are 2.9 ± 2.4 min, 0.9 ± 0.8 min, and 2.2 ± 2.1 min, respectively. Total durations and decay times for the x-ray events display a wide range of values from a few minutes to several hours. Rise times for 50% of the events fell in the range of 2 to 7 min. A significant fraction (32%) of the x-ray events may exhibit a flux enhancement prior to the main outburst. For 85% of the flare cases, the x-ray event begins simultaneously with or before the microwave event. In 91% of the cases the x-ray event peaks later than the microwave event. The average delay is 3.0 ± 1.9 min with 50% of cases in the range of 0 to 4 min. The x-ray flux increases are significantly correlated with the microwave flux increases, having a correlation coefficient of 0.43 (>99.9% confident). (auth)

9463 PAIRS OF NONFUNDAMENTAL-HARMONIC TYPE III BURSTS. Caroubalos, C.; Heyvaerts, J.; Pick, M.; Trottet, G. (Observatoire de Paris, Section de Meudon, 92 (France)). Solar Phys.; 37: No. 1, 205-214(Jul 1974).

Different forms of pairs of Type III bursts have been discussed in the literature. Here a new aspect is reported, revealed by high time resolution radioheliography. In some groups of these bursts, each element appears to be split into two components. These pairs recur with a characteristic time, and in a given group the time splitting of the two components of each pair is the same (one second or less). The nature of these pairs is discussed; the fundamental-harmonic hypothesis is excluded. Alternative interpretations are reviewed. (auth)

9464 CORONAL DENSITY STRUCTURES IN REGIONS OF TYPE III ACTIVITY. Leblanc, Y. (Observatoire de Paris, Section de Meudon, 92 (France)); Kuiper, T. B. H. (Maryland Univ., College Park (USA)); Hansen, S. F. (High Altitude Observatory, Boulder, Colo. (USA)). Solar Phys.; 37: No. 1, 215-223(Jul 1974).

The Mauna Loa K-corona data were examined to determine the density in regions of Type III activity which were observed during March and April, 1971, at Clark Lake Radio Observatory. It is found that these regions avoided the centers of dense structures in the corona. Both the K-corona data and the radio data indicated densities characteristic of the quiet corona. The density gradients determined from the K-corona and the radio data agreed to within their formal errors. (auth)

9465 ON THE PROBABILITY OF OCCURRENCE OF THE TYPE IIIb BURST AS A PRECURSOR. de La Noe, J. (Maryland Univ., College Park (USA)). Solar Phys.; 37: No. 1, 225-233(Jul 1974).

It is shown that a precursor Type IIIb burst is really associated with a Type III burst. The broad longitude distribution of occurrence of Type IIIb bursts also suggests that these bursts are emitted at a large angle to the open magnetic field in the corona. (auth)

9466 NUMERICAL INVESTIGATION OF NON-RESONANT AND RESONANT SCATTERING OF CHARGED PARTICLES WITH A SPATIALLY VARYING MAGNETIC FIELD. Webb, S.; Quenby, J. J. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). Solar Phys.; 37: No. 1, 235-249(Jul 1974).

By integrating many charged particle trajectories in a magnetic field model consisting of a series of equally spaced field discontinuities with equal angular displacements, constant and successive displacements oppositely directed, a parallel diffusion coefficient $K_{||}$ is obtained. The particle gyroradius was kept sufficiently small for the interaction to be nonresonant. The diffusion coefficient is found to be in good agreement with that predicted by the known reflection properties for charged particles of individual discontinuities. However an attempt to reproduce the diffusion coefficient using the results of a recent study by Klimas and Sandri of a nonlocal diffusion equation applying to the nonresonant case lead to too low a value of $K_{||}$. The computational approach was also applied to the case where the particle motion was in resonance with the wavelength of the train of discontinuities and a lower limit to K obtained. This lower limit exceeded the quasi-linear approximation value for K under resonant scattering conditions. (auth)

9467 ON THE EFFECTS OF ACCRETION AND FRAGMENTATION IN INTERPLANETARY MATTER STREAMS. Ip, W. H.; Mendis, D. A. (California Univ., La Jolla, San Diego (USA). Dept.

of Applied Physics and Information Science). Astrophys. Space Sci.; 30: No. 1, 233-241(Sep 1974).

The time evolution of interplanetary matter streams is studied using simple mathematical models, taking into account the effects of accretion and fragmentation. While the characteristic behavior is determined essentially by Λ_0, the initial ratio of the accretion time scale to the internal collision time scale, a focussing following an initial expansion is generally observed. The relevance of the results to cosmogenic Jet-Streams as well as present-day meteor streams is discussed. (auth)

9468 SEGREGATION OF THE HEAVY ELEMENTS IN THE SOLAR SYSTEM. Williams, I. P.; Handbury, M. J. (Queen Mary Coll., London (UK)). Astrophys. Space Sci.; 30: No. 1, 215-223 (Sep 1974).

The problem of the settling of heavy grains towards the center of a gaseous globe under the action of the gravitational field of the globe and resisted by the gas of the globe is investigated for the case when the globe is centrally condensed. It is found that the settling time is essentially the same as that for a globe of uniform density (investigated by McCrea and Williams, 1965) when the grains are growing by accretion. (auth)

9469 TRAPPED XENON IN METEORITES. Sabu, D. D. (Grambling Coll., LA); Hennecke, E. W.; Manuel, O. K. Nature (London); 251: No. 5470, 21-24(6 Sep 1974).

Xenon in meteorites can be resolved into a mixture of component X and trapped xenon with the following composition, ^{124}Xe: ^{126}Xe: ^{128}Xe: ^{130}Xe: ^{131}Xe: ^{132}Xe: ^{134}Xe: ^{136}Xe = 0.0276: 0.0248: 0.501: 1.00: 5.04: 6.19: 2.31: 1.90. This trapped meteoritic xenon is distinct from xenon trapped in the average carbonaceous chondrite which is shown to represent the average composition of the total xenon in meteorites containing various mixtures of component X and trapped meteoritic xenon. X refers to the meteoritic Xe component enriched in both the lighter and heavier isotopes relative to ^{130}Xe. (auth)

9470 ABUNDANCE OF CADMIUM AND ZINC IN METEORITES. Rosman, K. J. R.; De Laeter, J. R. (West Australian Inst. of Tech., South Bentley). Geochim. Cosmochim. Acta; 38: No. 11, 1665-1677(Nov 1974).

A stable isotope dilution technique using solid-source mass spectrometry has been used to accurately determine Cd and Zn in a wide range of materials. The abundance of Cd has been determined in 19 iron, 28 stone, and 1 stony-iron meteorites, together with a number of other samples. The abundance of Zn has also been determined for most of these samples. This has enabled the relationship between Cd and Zn to be examined in iron and stone meteorites. The abundance pattern of Zn in iron meteorites supports the existence of chemical groups. (auth)

9471 ENERGY DENSITIES OF ALFVÉN WAVES BETWEEN 0.7 AND 1.6 AU. Belcher, J.W.; Burchsted, R. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Geophys. Res. 79: No. 31, 4765-4768 (1 Nov 1974).

Plasma and field data from Mariner 4 and 5 between 0.7 and 1.6 AU are used to study the radial dependence of the levels of microscale fluctuation associated with interplanetary Alfvén waves. The observed decrease of these levels with increasing distance from the sun is consistent with little or no local generation or damping of the ambient Alfvén waves over this range of radial distance. (auth)

9472 EVIDENCE FOR LARGE–SCALE OSCILLATIONS OF THE SOLAR PHOTOSPHERE. Fossat, E.; Ricort, G.; Aime, C.; Roddier, F. (Département d'Astrophysique de l'I.M.S.P., Université de Nice). Astrophys. J. Lett. 193: No. 2, L97-L99 (15 Oct 1974).

Doppler shifts of the Na D_1 line, averaged over large solar areas up to the whole Sun, have been recorded with a sodium resonance device. The power spectra of the observed fluctuations show that (1) the 5–minute oscillation has an horizontal coherence of 35,000 km at the level of the sodium line formation; (2) the corresponding peak at 3.3 mHz is not predominant for scales greater than 5'. New oscillations appear with a 10–minute period. (auth)

9473 RADIOBURSTS IN THE SOLAR CORONA. Wild, J. P.; Smerd, S. F. Usp. Fiz. Nauk; 113: No. 3, 503-533(Jul 1974). (In Russian).

This review brings up to date a previous review of White and Smerd. It deals with radio emission caused by perturbations propagating in the corona (bursts of the II and III Types and moving bursts of Type IV). Under bursts of Type III, discussions are presented on electron energy, cosmic observations, velocity of the source and electron density model, temperature of the medium, theory of generation, role of the coronal magnetic field, and propagation and scattering of the radiation. Under bursts of Type II, there are discussions on source structure, observations and theory, refraction of shock waves, harmonics and splitting. In moving bursts of Type IV, there are presentations on the spectrum of synchrotron radiation in a plasma, observed differences in appearance of moving bursts of Type IV, a rising shock front, an expanding magnetic arc, and an isolated plasma cloud. Coronal pulsations and particle acceleration are discussed. 127 references. (JSR)

9474 ANALYSIS OF THE 0.511 MeV RADIATION AT THE OSO-7 SATELLITE. Dunphy, P. P. Durham, NH; Univ. of New Hampshire (1974). 138p. University Microfilms Order No. 74-21,092.

Thesis (Ph. D.).

Observations of the 0.511 MeV positron-annihilation gamma ray by the UNH detector on the OSO-7 satellite are presented along with a description of the detector itself. Variables which affect the counting rate for this line are discussed. Local production is shown to be important, and a contribution from the earth is found to be in agreement with that measured by balloon-borne detectors. An upper limit flux of 7.6×10^{-3} photons cm^{-2}sec^{-1} is obtained for the quiet sun and a positive solar flux of 6.3×10^{-2} ($\pm 2.0 \times 10^{-2}$) photons cm^{-2}sec^{-1} is obtained for the 3B flare of August 4, 1972. The width of this annihilation line gives an upper limit temperature for the annihilation region of $\approx 6 \times 10^{6}$°K. An analysis of the line width and position also shows that the contribution to the line from positronium annihilation is less than 100% at the 99% confidence level. An upper limit is also found for an isotropic cosmic flux. This is 8×10^{-3} cm^{-2}sec^{-1}sr^{-1}. (Diss. Abstr. Int., B)

9475 PHYSICS OF SOLAR COSMIC RAYS. Sakurai, K. Portland, OR; International Scholarly Book Service, Inc. (1974). 438p. $35.00.

The topics discussed are an historical review, solar atmosphere, interplanetary space, and solar activity, solar flares and associated phenomena, generation of solar cosmic rays, the mechanism of solar flares, the acceleration mechanism of solar cosmic rays, propagation of solar cosmic rays, the steady flow of energetic protons and solar active regions, and the origin theory of cosmic rays. (JFP)

9476 CHARGE COMPOSITION OF SOLAR COSMIC RAYS IN THE JANUARY 25, 1971 SOLAR FLARE. Pellerin, C. J. Jr. Washington, DC; Catholic University of America (1974). 141p. University Microfilms Order No. 74-19,735.

Thesis (Ph. D.).

A detailed study of the charge composition of solar cosmic rays measured in the January 25, 1971 solar flare is presented. Differential fluxes for the even charged nuclei from carbon through argon are given and differential energy spectra are presented whenever the statistical uncertainties are sufficiently small. The measurements are obtained for varying energy intervals for each nuclear species in the energy range from 11 to 35 MeV/nucleon. In addition, abundances relative to oxygen are computed for all the above nuclei in the energy interval from 15 to 25 MeV/nucleon. This interval is common to all the species and as a result requires no spectral extrapolations. An upper limit for the abundance of calcium nuclei is also presented. The most detailed charge composition measurements to date for this energy region where the sample was obtained in a short time interval (245 seconds), compared to the duration of a major solar event is presented. The measurements were made in nuclear emulsion stacks exposed over Ft. Churchill. The stacks were carried above the atmosphere by a Nike-Apache sounding rocket. This detailed analysis was made possible by utilizing a digitized TV microscope system developed during this experiment. This system, operating on-line to two high-speed digital computers, measured particle track widths in nuclear emulsion as a function of residual range by analyzing the video output of a television camera, and thus enabled the charges of the nuclei to be determined. These measurements, when combined with other experimental results, enable the energy dependence of abundance measurements as a function of nuclear charge to be discussed. It is seen that at energies above about 10 MeV/nucleon, the enhancements of abundance ratios are limited to about a factor of 3 from flare to flare, in spite of large variations in other characteristics of these solar events. Although the high energy (>50 MeV/nucleon) data are scarce, the data are consistent with the concept that the abundance ratios are representative of the solar atmosphere. Solar particle acceleration models and the implications of the measurements presented herein are then discussed. (Diss. Abstr. Int., B)

Galaxies

Refer also to abstracts 9336, 9366, and 9378.

9477 (AD-779371) APERTURE SYNTHESIS OBSERVATIONS OF HI IN THE GALAXY M83. Rogstad, D. H.; Lockhart,

L. A.; Wright, M. C. H. (Owens Valley Radio Observatory, Pasadena, Calif. (USA)). 1974. Contract N00014-67-A-0094-0019. 32p. NTIS $3.25.

High resolution observations of neutral hydrogen in the spiral galaxy M83 reveal a very extended HI distribution and a peculiar velocity field. An interpretation is presented in terms of substantial warping of the plane of the galaxy for the material outside the optical image. The time scale for persistence of this bending is estimated to be longer than two billion years. (auth)

9478 (UCID-16089) LAST RITES FOR ROX-3. Grader, R. J.; Hill, R. W.; Stoering, J. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1972. 16p. Dep. NTIS $4.00.

The re-analysis of ROX-3 data has shown that the low energy spectrum of the Crab Nebula and the valuable information that these data may reveal regarding interstellar absorption is still a mystery. Another source was revealed probably IC-443 and given a reasonably good background measurement. (auth)

9479 MOLECULES IN THE GALACTIC ENVIRONMENT. Gordon, M. A.; Snyder, L. E. (eds.). New York; John Wiley and Sons, Inc. (1973). 482p. $18.95.

Stellar life cycles and cosmic abundances are considered along with questions of the thermodynamic structure of clouds, a study of dark nebulae, and the chemical and physical properties of interstellar dust. Other subjects discussed are related to observations of molecules in the interstellar medium, investigative techniques, theoretical models of molecular excitation, and questions of astrochemistry. Biological implications of the results of the studies of the interstellar medium are also explored, giving attention to the significance of interstellar molecules for prebiotic chemistry, the formation of interstellar molecules in solar nebulae, thermodynamics and the origin of life, and developments concerning the organic chemistry and biology of the interstellar medium. Separate abstracts are prepared for 32 chapters. (IAA)

For abstracts of individual chapters see: 9337, and 9480–9510.

9480 STELLAR LIFE CYCLES AND COSMIC ABUNDANCES. Iben, I. Jr. (Joint Inst. for Laboratory Astrophysics, Boulder, CO). pp 3-20 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

Much of the interdisciplinary interest in the discoveries of the interstellar molecular spectroscopist is connected with the thought that much of the chemical buildup which precedes the development of the most elementary life forms may have taken place in space. Questions of element formation are considered, taking into account hydrogen, helium, and the heavy elements. Stellar stirring mechanisms and mass ejection mechanisms are discussed along with obstacles to a quantitative theory of element enrichment due to stars. Aspects of element synthesis in stars are also explored, giving attention to the core hydrogen burning phase, the central helium burning phase, the shell helium burning phase, and core carbon burning. (IAA)

9481 THERMODYNAMIC STRUCTURE. Field, G. B. (Univ. of California, Berkeley). pp 21-52 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

Questions of interstellar gas equilibrium are considered, giving attention to the observational testing of the thermal equilibrium of H II regions and to conditions in H I regions. The heating and cooling of H I regions is discussed along with the evolution of clouds in the two-phase model and questions of molecule formation in normal clouds. Predicted and observed properties of interstellar H I near the galactic plane are listed and the effect of gravitation on the mean density of an isothermal cloud in hydrostatic equilibrium is shown. Aspects regarding the chemical and thermal equilibrium of dark clouds are also explored. (IAA)

9482 STUDY OF DARK NEBULAE. Bok, B. J.; Cordwell, C. S. (Steward Observatory, Tucson, AZ). pp 53-90 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

It is pointed out that dark nebulae are very likely closely linked with star formation. A discovery of the physical processes taking place in these areas is, therefore, important for an understanding of preprotostar conditions. A brief summary of different types of dark nebulae is presented together with the representative properties for each variety. Methods are discussed for finding approximate absorptions and distances of dark clouds through the use of star count data and from results obtained with modern color techniques. (IAA)

9483 CHEMICAL AND PHYSICAL PROPERTIES OF INTERSTELLAR DUST. Greenberg, J. M. (New York State Univ., Albany). pp 93-124 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

The interstellar dust appears to play a critical role in the formation of the interstellar molecules. Various theories of dust formation are considered along with questions concerning the distribution and the amount of dust. Observational criteria for grain materials are discussed, giving attention to extinction, scattering, discrete features, and polarization. The characteristics of the ultraviolet radiation field are examined together with relations regarding the ultraviolet absorption by solids and molecules. Effects of radiation on dust and molecules are investigated. (IAA)

9484 DISTRIBUTION OF INTERSTELLAR MOLECULES. Turner, B. E. (National Radio Astronomy Observatory, Green Bank, WV). pp 143-154 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

The distribution of OH in the Galaxy is considered, taking into account aspects of large-scale distribution of OH, questions regarding the association of OH with continuum sources, and the relation of OH with extinction. The distribution of formaldehyde in the Galaxy is investigated, giving attention to the relationship of OH and H_2CO and the general excitation of H_2CO. The occurrence of ammonia and water molecules is also discussed. (IAA)

9485 KINETIC TEMPERATURE OF DENSE INTERSTELLAR CLOUDS DETERMINED FROM CO OBSERVATIONS. Solomon, P. M. (Univ. of Minnesota, Minneapolis). pp 155-164 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9486 OH AND H_2O MICROWAVE EMISSION FROM INFRARED STARS. Wilson, W. J. (Aerospace Corp., El Segundo, CA). pp 165-171 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9487 CHEMICAL AND ROTATIONAL STATE STABILITY OF INTERSTELLAR FORMAMIDE. Flygare, W. H. (Univ. of Illinois, Urbana); Benson, R. C.; Tigelaar, H. L.; Rubin, R. H.; Swenson, G. W. Jr. pp 173-179 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9488 DETECTION OF ACETALDEHYDE IN SAGITTARIUS. Gottlieb, C. A. (Harvard College Observatory, Cambridge, MA). pp 181-186 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9489 DETECTION OF A MM-WAVE TRANSITION OF METHYL ACETYLENE. Buhl, D. (National Radio Astronomy Observatory, Green Bank, WV); Snyder, L. E. pp 187-191 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

The 3.5-mm line methyl acetylene was detected in the galactic center source Sgr B2 in May of 1971. The line was observed with a 36-foot telescope and a 3-mm mixer radiometer. A search for the first two levels of the molecule was not successful. It is concluded that the excitation of the methyl acetylene molecule is probably thermal. Any inversion of the ground state would be easily detectable. (IAA)

9490 MEASUREMENTS OF THE LAMBDA 6CM H_2CO EXCITATION TEMPERATURE IN DARK CLOUDS. Heiles, C. (Univ. of California, Berkeley). pp 193-197 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9491 STUDY OF FORMALDEHYDE 6-CM ANOMALOUS ABSORPTION. Kutner, M. L. (Columbia Univ., New York). pp 199-206 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

The cloud studied lies in the Taurus complex of dark nebulae, and Heiles' Cloud 2, where anomalous absorption was discovered by Palmer et al. (1969). A 140-foot telescope was used in the investigations. A number of the H_2CO spectra observed are shown. There is a smooth velocity shift observed across the cloud, but no evidence of large velocity gradients. A comparison of radio and optical data indicates a rather close correlation between the line brightness temperature and the optical extinction. The obtained data are not sufficient to determine the mechanism responsible for the observed anomalous cooling. (IAA)

9492 KINEMATICS OF MOLECULAR CLOUDS IN THE NUCLEAR DISC. Scoville, N. Z. (Columbia Univ., New York). pp 207-214 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

The large scale dynamics of the clouds in the galactic center can be studied best in the 18-cm OH and 6-cm H_2CO absorption lines and the 2.6-mm CO emission line. Evidence is introduced that the considered clouds are in the nuclear disk. It is shown that the clouds may be joined up into one continuous feature. The elliptical shape of the sequence of clouds in the longitude-velocity diagram might be described kinematically as a ring that is rotating and is either expanding or contracting. (IAA)

9493 ISOTOPE ABUNDANCES IN INTERSTELLAR MOLECULES. Zuckerman, B. (Univ. of Maryland, College Park). pp 215-220 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9494 ABC'S OF FREQUENCY CALCULATIONS. Wilson, E. B. (Harvard Univ., Cambridge, MA). pp 223-232 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

Approaches are considered for predicting the microwave spectrum of a molecule which has not been studied in the laboratory. It is pointed out that the predicted spectrum can be close enough to be useful as a preliminary to a laboratory investigation. In some cases the predicted spectral characteristics can even be of help in astronomical studies. Most spectra studied so far have involved mainly changes in usual energy terms related to rigid rotation, centrifugal distortion, tunneling, Coriolis effects, electron spin-rotation, and nuclear quadrupole coupling. (IAA)

9495 XYZ'S OF LABORATORY FREQUENCY MEASUREMENTS. Lide, D. R. Jr. (National Bureau of Standards, Washington, DC). pp 233-246 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

A summary is presented of present and past techniques for measuring the frequencies of microwave absorption lines in the laboratory. Special attention is given to the reliability of laboratory frequency measurements and to the dependability of predictions made from them. Useful sources of data on microwave frequencies and related quantities are also provided. (IAA)

9496 CENTRIFUGAL DISTORTION AND PREDICTABILITY IN THE MICROWAVE SPECTRUM OF FORMAMIDE. Johnson, D. R.; Kirchhoff, W. H. (National Bureau of Standards, Washington, DC). pp 247-252 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9497 SELECTIVE PREDISSOCIATION AS A POSSIBLE MECHANISM FOR THE POPULATION INVERSION OF INTERSTELLAR H_2O. Oka, T. (National Research Council, Ottawa). pp 257-265 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9498 MIRA VARIABLES AS BLACK CLOUDS. Woolf, N. (Univ. of Minnesota, Minneapolis). pp 289-293 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9499 PROPOSED NEW METHOD FOR STUDYING INTERSTELLAR MOLECULES. Mumma, M. J.; Donn, B. D. (Goddard Space Flight Center, Greenbelt, MD). pp 295-301 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9500 CHEMISTRY IN INTERSTELLAR SPACE. Donn, B. (Goddard Space Flight Center, Greenbelt, MD). pp 305-312 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

The particular characteristics of chemistry in interstellar space are determined by the unique environmental conditions involved. Interstellar matter is present at extremely low densities. Large deviations from thermodynamic equilibrium are, therefore, to be expected. A relatively intense ultraviolet radiation is present in many regions. The temperatures are in the range from 5 to 200°K. Data concerning the inhibiting effect of small activation energies in interstellar clouds are presented in a table. A summary of measured activation energies or barrier heights for exothermic exchange reactions is also provided. Problems of molecule formation are discussed, taking into account gas phase reactions and surface catalyzed processes. (IAA)

9501 PHOTOCHEMISTRY OF INTERSTELLAR MOLECULES. Stief, L. J. (Goddard Space Flight Center, Greenbelt, MD). pp 313-327 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

The role of photochemistry in determining the lifetime of interstellar molecules is considered. The probability of photodecomposition depends on three factors, including the absorption cross section, the quantum yield or probability of dissociation following photon absorption, and the interstellar radiation field. A more detailed discussion of the photochemistry of five molecules is presented, giving attention to carbonyl sulfide, methyl acetylene, nitric oxide, acetylene, and benzene. Lifetimes of interstellar molecules in unobscured regions are in the range from 5 to 100 years. It is concluded that polyatomic molecules can exist only in dense clouds which protect them from the full interstellar radiation field. (IAA)

9502 REACTION DYNAMICS AND THE INTERSTELLAR ENVIRONMENT. Polanyi, J. C. (Univ. of Toronto). pp 329-351 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

Following a brief outline of the "normal" equilibrium reaction rate laws, the theme of thermal disequilibrium in interstellar space and the related topic of detailed rate constants are more extensively discussed. Comment is made concerning the two principal techniques that are currently being used to explore the dynamical details of an increasing range of chemical reactions in the laboratory, since it is considered that these techniques suggest ways in which the understanding of the chemistry of interstellar space may be extended. (IAA)

9503 MOLECULE FORMATION BY INVERSE PREDISSOCIATION. Julienne, P. S.; Krauss, M. (National Bureau of Standards, Washington, DC). pp 353-373 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

The general theory of inverse predissociation is described, and is applied to specific molecules. The list of molecules which can be formed by radiative association will be lengthened considerably by considering this phenomenon. Typical rate constants for diatoms will lie in the range 10^{-16} to 10^{-20} cm^3/s/molecule, with the heavy atom molecules such as CN, CO, or NO generally having larger rates than the hydrides. An attempt is made to point out what molecular characteristics determine the radiative association rate and also to make estimates of what rates may be expected for various interstellar molecules. The formal theory is developed, and the molecular properties are discussed which determine the inverse predissociation rate. The details of the theory as applied to specific interstellar molecules are studied. (IAA)

9504 MOLECULE FORMATION ON INTERSTELLAR GRAINS. Watson, W. D.; Salpeter, E. E. (Cornell Univ., Ithaca, NY). pp 375-380 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

A discussion is given of two classes of possible molecule formation on interstellar grains. In one, attachment of hydrogen atoms to heavy particles to form CH, NH, OH, CH_4, or H_2O is the first step. The second general class of surface reactions is the formation of complex molecules (CH_3OH, etc.). The general requirements for molecule formation on interstellar grains, the ejection of the product molecules from the grain surface, and molecule abundances are considered. (IAA)

9505 GAS-SOLID INTERACTIONS: LABORATORY PARADIGMS FOR REACTIONS ON INTERSTELLAR GRAINS. Klein, R. (National Bureau of Standards, Washington, DC). pp 389-398 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

9506 EXPERIMENTAL INTERSTELLAR ORGANIC CHEMISTRY: PRELIMINARY FINDINGS. Khare, B. N.; Sagan, C. (Cornell Univ., Ithaca, NY). pp 399-408 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

A review is presented of the results of some explicit experimental simulation of interstellar organic chemistry consisting in low-temperature high-vacuum uv irradiation of condensed simple gases known or suspected to be present in the interstellar medium. The results include the finding that acetonitrile may be present in the interstellar medium. The implication of this and other findings are discussed. (IAA)

9507 MOLECULE FORMATION IN NORMAL CLOUDS. Aannestad, P. A. (Univ. of California, Berkeley). pp 409-412 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

Some aspects of molecule formation in normal interstellar clouds, i.e., clouds having particle densities of less than 100 per cu cm, are discussed in light of recent studies. It is pointed out that, with their relatively large depletion parameter values (DPVs), CH clouds are "young", whereas OH clouds have small DPVs and are "old". The theoretical reason for this is that OH, as a product of grain catalysis, persists over a much longer period of cloud evolution, whereas CH(+), CH, and CN, as products of gas-phase reaction, can be found only in "young" clouds where depletion has not yet occurred. This may explain why OH has not been seen in radio observations of regions where CH(+), CH, and CN have been seen optically. (IAA)

9508 INTERSTELLAR MOLECULES: SIGNIFICANCE FOR PREBIOTIC CHEMISTRY. Ponnamperuma, C. (Univ. of Maryland, College Park). pp 415-428 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

A discussion is given of experimental investigation results on the synthesis of prebiotic molecules, with special attention to the abiogenic synthesis of nucleic acids and proteins. The synthesis of macromolecules is considered under aqueous and hypohydrous conditions, along with the chemical mechanisms involved in abiotic synthesis experiments. The results of Jupiter simulation and meteorite studies are reviewed, particularly, those of the Murchison (Australia, 1969) meteorite. It is shown that the pathways of chemical evolution to prebiotic molecules appear to be commonplace throughout the cosmos. (IAA)

9509 INTERSTELLAR MOLECULES. Formation in Solar Nebulae. Anders, E. (Chicago Univ.). pp 429-442 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

Herbig's (1970) hypothesis that solar nebulae might be the principal source of interstellar grains and molecules is investigated. The investigation includes the determination of physical and chemical conditions in the early solar system. The production of organic compounds in the solar nebula is studied, and the compounds in meteorites are compared with those obtained in Miller–Urey and Fischer–Tropsch-type (FTT) reactions, taking into consideration aliphatic hydrocarbons, aromatic hydrocarbons, purines, pyrimidines, amino acids, porphyrins, and aspects of carbon-isotope fractionation. It is found that FTT reactions account reasonably well for all well-established features of organic matter in meteorites investigated. The distribution of compounds produced by FTT reactions is compared with the distribution of interstellar molecules. Biological implications of the results are considered. (IAA)

9510 ORGANIC CHEMISTRY AND BIOLOGY OF THE INTERSTELLAR MEDIUM. Sagan, C. (Cornell Univ., Ithaca, NY). pp 451-468 of Molecules in the Galactic Environment. Gordon, M. A. (ed.). New York; John Wiley and Sons, Inc. (1973).

Interstellar organic chemistry is discussed as the field of study emerging from the discovery of microwave lines of formaldehyde and of hydrogen cyanide in the interstellar medium. The reliability of molecular identifications and comparisons of interstellar and cometary compounds are considered, along with the degradational origin of simple organics. It is pointed out that the contribution of interstellar organic chemistry to problems in biology is not substantive but analogical. The interstellar medium reveals the operation of chemical processes which, on Earth and perhaps on vast numbers of planets throughout the Universe, led to the origin of life, but the actual molecules of the interstellar medium are unlikely to play any significant biological role. (IAA)

9511 WHAT CAN DEUTERIUM TELL US. Schramm, D. N.; Wagoner, R. V. (Univ. of Chicago). Phys. Today; 27: No. 12, 41-47(Dec 1974).

The discussion of the relative abundance of deuterium in the galaxy covers observations of deuterium abundance, deuterium production and destruction, possible astrophysical production sites, deuterium from supernova shock waves, deuterium versus light elements, deuterium from the primeval fireball, and an open universe. (JFP)

9512 GALAXY MAGNITUDES. II. The Limiting Magnitude of the Lick Galaxy Survey. Kron, G. E. (Australian National Univ., Canberra); Shane, C. D. (Lick Observatory, Santa Cruz, Calif., U.S.A.). Astrophys. Space Sci.; 30: No. 1, 127-134(Sep 1974).

An improved definition of limiting magnitude of galaxy counts is proposed. It depends on the probability, $\Phi(m)$, of identifying and counting a galaxy of magnitude m. A plausible formula for $\Phi(m)$ containing two constants is assumed and a method for calculating the constants from observations is developed. Some of the faintest galaxies counted in the Lick galaxy program (Shane and Wirtanen, 1967) were measured photoelectrically with the Lick 120-in., telescope, and from these measures the constants in $\Phi(m)$ were determined. The resulting limiting magnitude of the Lick counts is $B_1 = 18.90$. (auth)

9513 ELECTRIC POTENTIAL ON SOLID SPHERES IN A PLASMA. De, B. R. (California Univ., La Jolla, San Diego (USA). Dept. of Applied Physics and Information Science). Astrophys. Space Sci.; 30: No. 1, 135-147(Sep 1974).

The general expression for the potential on a solid sphere immersed in a plasma is derived, showing the dependence of the potential on the radius a of the sphere and s of the plasma sheath that develops around the sphere. In the limit where the radius a is much larger than the sheath thickness s—a the well-known result for the potential on an infinite wall in contact with a plasma is recovered from this expression. On the other extreme where s is much larger than a, the result derived by Spitzer (1941) for the potential on spherical grains in the interstellar plasma is obtained. Since the surface of the sphere forms a sink for the charged particles, there is a net drift of the plasma towards the surface. The effect of this drift on the potential is examined. Finally, for very small metallic spheres, an effect leading to a revision of the potential is discussed. This effect consists in a lowering of the potential barrier for the electrons due to the image force. The various effects limiting the potential on spheres are discussed. (auth)

9514 SPIRAL STRUCTURE AND HYDRODYNAMIC GRAVITATIONAL RESONANCE. Simon, R. (Liege Univ. (Belgium). Inst. d'Astrophysique). Astrophys. Space Sci.; 30: No. 1, 149-161(Sep 1974).

A persistent and large scale galactic spiral structure might be the result of resonant excitation of density waves, forced in the low-viscosity interstellar gas, by the gravitational field of an asymmetric stellar structure (galactic nucleus, condensation, companion galaxy, etc.) rotating like a rigid body around the galactic center. This paper deals with this problem in the simple case of a homogeneous plane viscous medium of infinite extent, in a state of rigid body rotation. Numerical estimates are given in the case of density waves excited by the gravitational field of a central dumb-bell. They show that the mechanism of hydrodynamic gravitational resonance is worthy of a further, more realistic, treatment. (auth)

9515 U93.174: A NEW INTERSTELLAR LINE WITH QUADRUPOLE HYPERFINE SPLITTING. Turner, B.E. (National Radio Astronomy Observatory). Astrophys. J. Lett. 193: No. 2, L83-L87 (15 Oct 1974).

A new interstellar triplet of microwave lines has been discovered at 93.174 GHz. The relative intensities and frequencies of the triplet indicate a $J = 1 \rightarrow 0$ transition of a molecule containing an atom with nuclear spin of 1, very likely nitrogen, occupying an "out-board" position in the molecule. Based on these clues, Green et al. suggest N_2H^+ as an identification. The molecule is widespread in the Galaxy but appears to have rather lower abundance than H_2CO, CS, and NH_3. (auth)

9516 TENTATIVE IDENTIFICATION OF U93.174 AS THE MOLECULAR ION N_2H^+. Green, S.; Montgomery, J.A. Jr. (Chemistry Department, Columbia University); Thaddeus, P. Astrophys. J. Lett. 193: No. 2, L89-L91 (15 Oct 1974).

On the basis of a self–consistent field calculation of its rotation constant and hyperfine structure, it is suggested that the molecular ion N_2H^+ is the carrier of the unidentified interstellar triplet reported by Turner in the preceding Letter. The calculated frequency of the $J=1\rightarrow0$ transition of N_2H^+ is 92.2 ± 1.8 GHz, in good agreement with the observed 93.1 GHz. Similarly, the calculated value of the quadrupole coupling constant for the outer nitrogen is -5.3 ± 0.5 MHz, while the coupling constant deduced from the observations is -5.7 MHz. Equally important to the assignment, the quadrupole coupling for the inner nitrogen is calculated to be only -1.2 ± 0.5 MHz, making its contribution to the hyperfine structure too small to be resolved in the sources so far observed. Detection of this additional structure in sources with very narrow lines would provide additional confirmation of the assignment. (auth)

9517 THE NATURE OF IRREGULAR II GALAXIES. Krienke, O.K. Jr.; Hodge, P.W. (Astronomy Department, University of Washington, Seattle, Washington 98195). Astron. J. 79: No. 11, 1242-1247 (Nov 1974).

The various criteria used to classify galaxies as Irr II are examined with the aid of recent data and a truth table. It is concluded that the class probably consists of two (or possibly three) different kinds of objects, physically unrelated. On the one hand there are the explosive and post–explosive galaxies, while on the other hand, there are those distorted by probable gravitational interaction with a companion. (auth)

9518 PHYSICAL STATE OF INTERSTELLAR ATOMS. York, D. G. (Princeton Univ., NJ). Proc. Roy. Soc. (London), Ser. A; 340: No. 1623, 447-455(8 Oct 1974).

A brief survey is given of the physical conditions along the lines of sight to reddened and unreddened stars, as determined from Copernicus observation of interstellar lines between 95 and 300 nm. Differences in ionization structure and density between clouds and the local intercloud medium are discussed. Some new data for β Centauri is used to supplement the previously available data. (auth)

9519 INTERSTELLAR MOLECULES. Drake, J. F. (Princeton Univ., NJ). Proc. Roy. Soc. (London), Ser. A; 340: No. 1623, 457-469(8 Oct 1974).

Scans were made at the absorption wavelengths of 14 molecules resulting in the detection of three molecules: H_2, HD, and CO. Lines of H_2 were measured in all 11 reddened stars ($E_{B-V} > 0.10$) analyzed with f, the fraction of hydrogen in molecular form, exceeding 10^{-1}. In eight of nine unreddened stars ($E_{B-V} < 0.05$) no H_2 lines were detected limiting f to less than 10^{-7}. Ratios of orthohydrogen ($J = 1$) to parahydrogen ($J = 0$) correspond to an average excitation temperature of 81°K. Two HD lines have been measured in nine stars yielding a ratio of HD to H_2 of about 10^{-6}. Consideration of the differences in self-shielding between H_2 and HD for disruption by ultraviolet photons indicates that one HD molecule is formed and dissociated for about every 200 H_2 molecules. Column densities for CO for four reddened stars have been determined. Ratios of the J = 1 to J = 0 rotational levels in CO yield an excitation temperature of 5°K for CO toward three stars. (auth)

9520 EXISTENCE OF CLUSTERS OF SECOND-ORDER GALAXIES. Kalinkov, M. Izv. Sekts. Astron., Bulg. Akad. Nauk.; 5: 165-177(1972). (In Russian).

Arguments in favor of the existence of clusters of second-order galaxies are given. The method applied consists in the making up of synthetic contour maps giving the distribution of the galactic clusters in fixed intervals of distance. Observation material from the catalog of Zwiki, etc. was used. The region examined is situated around the north galactic pole ($b^{\prime\prime} \geq +65°$, 02), an area of 1932.54 square degrees, containing 2,147 clusters of galaxies. Isoplethic maps were drawn up of clusters of the classes $\Sigma' = N + MD + D$; ED and $\Sigma = N + MD + D + VD + ED$. Information about the supposed superclusters of galaxies is provided which meet the conditions: to have a surface density twice as high as the density of the background in the region studied, and to occupy an area of not less than 10 square degrees. (auth)

Cosmology

Refer also to abstract 10225.

9521 RELATIVISTIC PHASE TRANSITION. Kirzhnits, D. A.; Linde, A. D. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 4, 1263-1275(Oct 1974). (In Russian).

A theory of a phase transition in the relativistic scalar model with spontaneous breakdown of symmetry is proposed, the model being an integral part of a unified theory of weak and electromagnetic interactions. It is pointed out that in processes involving variation of temperature (and in particular on evolution of a hot Universe), violation of energy balance of matter occurs due to the energy being ⟨⟨pumped⟩⟩ from the unobservable Bose-condensate. (auth)

9522 CONVIVIUM COSMOLOGICUM: INTERDISCIPLINARY STUDIES. Giannaras, A. (ed.). Wissenschaft und Kultur., Volume 29. Basel; Birkaeuser Verlag (1973). 216p. (In German and English). $11.80.

A collection of mixed scientific, philosophical, and philological essays is presented that trace the development of human thought on cosmological problems and reveal the continuity of the scientific tradition and the humanistic legacy in dealing with this subject. Articles on cosmological thinking in the pre-Socratic Greek and later philosophers alternate with strict mathematical discussions of some difficult problems in general relativity and quantum field theory. Topics include cosmology and empire, the basic concept of quantum mechanics, color as a parable of the world, brightness of the sky and the Einstein–Friedmann cosmology, singularities in the Born approximation, the questionable existence of matter, the space beyond the cosmos, Ptolemy and Kepler, choice of cosmic models, singularities in general relativity, Hayden's "Creation", and the heuristic considerations relevant to Mach's principle. Separate abstracts are prepared for 3 papers. (IAA)

For abstracts of individual papers see: 9523–9525.

9523 BRIGHTNESS OF THE SKY AT NIGHT AND THE EINSTEIN–FRIEDMANN COSMOLOGY. Dehnen, H.; Nowotny, E. pp 65-85 of Convivium Cosmologicum: Interdisciplinary Studies. Giannaras, A. (ed.). Basel; Birkaeuser Verlag (1973). (In German)

It is found that information about the curvature of the Universe as a whole can be obtained by studying the radiant flux from remote galaxies. This flux should be affected by different curvature conditions through the mediating influence of the law of expansion of the Universe. The Einstein–Friedmann theory is chosen as a basis for the discussion of this relationship, which is necessarily dependent on the particular cosmology used as a starting point. The maximum of the spectral distributions is located in the short infrared at about 1.5 microns; at present there are no available techniques for measuring something that would corroborate the above views. Only the comparison of predicted and observed intensities of the 3 K background radiation demonstrates unambiguously the cosmic origin of that radiation, presumably as the result of a primal bang. (IAA)

9524 ASTRONOMICAL OBSERVATIONS AND COSMOLOGICAL MODELS. Mattig, W. pp 169-180 of Convivium Cosmologicum: Interdisciplinary Studies. Giannaras, A. (ed.). Basel; Birkaeuser Verlag (1973). (In German)

The results of galactic observations are compared with the predictions of the various cosmological models with the aim of distinguishing among all the possible curvatures that could exist in nearby space. Only simple models are considered, namely those based on the Einstein theory with a vanishing cosmological term. The Einstein theory maintains itself as a valid description, but it is still impossible to settle on any one model of this class, despite the fact that adequate observational evidence exists. However, the redshifts in far galaxies and density determinations in nearby space both seem to indicate an acceleration parameter in the range 0.1 to 1.0. Therefore an open, hyperbolically curved space is the most likely outcome, although a Euclidean or spherical space is not excluded. (IAA)

9525 SINGULARITIES IN GENERAL RELATIVITY. Papapetrou, A. (CNRS, Paris). pp 181-184 of Convivium Cosmologicum: Interdisciplinary Studies. Giannaras, A. (ed.). Basel; Birkaeuser Verlag (1973).

Some features of general relativity are discussed. The main properties of the noncosmological singularities appearing in solutions for limited physical systems are reviewed. Different types of black holes are discussed, and the physical meaning of such singularities is considered. Two consequences of the theory are the existence of states of matter to which the concept of motion is not applicable and the existence of several space–times interrelated through black holes. (IAA)

9526 RADIATION IN COSMOLOGICAL BACKGROUNDS. Change, S. C. Pittsburgh; Univ. of Pittsburg (1974). 129p. University Microfilms Order No. 74-24,175.

Thesis (Ph. D.).

Scalar and gravitational radiation in Friedmann backgrounds with positive, negative, and zero spatial curvature was studied and an attempt was made to answer the question under what circumstances a wave propagates with or without a tail. Based on Newman–Penrose formalism, a basic wave equation was derived for pure gravitational radiation in Friedmann backgrounds. This wave equation coupled with a scalar wave equation serves as the basis of the study. After expanding the wave function in terms of spherical harmonics, a set of two-dimensional wave equations is obtained. A sufficient condition under which these wave equations represent propagation of waves without a tail is then given. It is found that two physically important backgrounds in which P = 0 and $P = \frac{1}{3}\rho$ (P = pressure, ρ = density), respectively, belong to the group of so-called nondissipative backgrounds, i.e., the backgrounds in which scalar and gravitational waves propagate without a tail. In the process of the investigation, a set of two-dimensional wave equations with closed form solutions was discovered. These equations, which represent characteristic propagation, could be used to test the validity of certain conjectures about the forms of wave equations which admit characteristic-propagation solutions. (Diss. Abstr. Int., B)

9527 DIRAC'S COSMOLOGICAL COINCIDENCE: AN EXPLANATION. Clutton-Brock, M. (Newcastle upon Tyne Univ. (UK). Dept. of Physics). Astrophys. Space Sci.; 30: No. 1, L1-L3(Sep 1974).

In a previous paper, the author suggested that the Universe could have been homogenized when the particle horizon was smaller than the Compton wavelength of the pion. This hypothesis also explains in a very natural manner the curious coincidence, noticed by Dirac in 1937, between atomic and cosmological constants. (auth)

9528 SOME REMARKS ABOUT COSMOLOGY IN BRANS AND DICKE'S THEORY. Lessner, G. (Konstanz Univ. (F. R. Germany). Fachbereich Physik). Astrophys. Space Sci.; 30: No. 1, L5-L7(Sep 1974).

It is established that, in contrast to Einstein's theory, in the cosmological equations of the theory by Brans and Dicke the spatial component of the field equations follows from the remaining equations and the conservation law $T^{ik}jk = 0$ only if one excludes the power law $\phi \sim R^{-2}$. Some consequences are discussed. (auth)

9529 METRIC CONDITIONS FOR CLUSTERS IN HIERARCHICAL COSMOLOGIES. Wesson, P. S. (Cambridge Univ. (UK)). Astrophys. Space Sci.; 30: No. 1, 71-94(Sep 1974).

Algebraic conditions on the continuity of the components of the metric tensor are employed to get an approximate metric in four limiting forms relevant to a condensation in an expanding Einstein/de Sitter substratum. The metric of the condensation is in general spherically-symmetric, nonstatic and asymptotically flat, passing over into the usual Friedmann solution at large distances and late times. The line-element derived supersedes an earlier incorrect formulation of the problem by Einstein and Straus. The metric is applicable in particular to clusters of galaxies, which cannot avoid being involved in the expansion of the Universe for the density-distributions relevant to average loose clusters as presently observed. It is likely that all clusters, including compact ones, are in a state of dynamical evolution, a conclusion which may remove the missing mass problem. The results found agree, in this respect, with recent work by Noerdlinger and Petrosian, and give effective Hubble parameters for systems in an expanding substratum. (auth)

9530 EXPANDING CLUSTERS OF GALAXIES AS COMPONENTS OF A RELATIVISTIC HIERARCHICAL COSMOLOGY. Wesson, P. S. (Cambridge Univ. (UK)). Astrophys. Space Sci.; 30: No. 1, 95-114(Sep 1974).

Approximate metrics for clusters embedded in an expanding Robertson/Walker background indicate that in general clusters of galaxies remain uninfluenced by the expansion. The potential for an expanding cluster is seen to suggest that clusters as presently observed are not in static equilibrium and that the missing mass problem can be elucidated via use of the virial theorem given certain density conditions in compact clusters. Noncompact clusters can be treated similarly, and it is found that the behavior of a low-density cluster is equivalent to that of a domain of a Friedmann ($k = 0$) model Universe. The treatment of compact clusters is based on approximate metrics for clusters embedded in a Robertson/Walker background. These comparisons lead to information on the evolution of noncompact clusters and compact clusters, and to observable consequences that seem to be borne out successfully. Data on clusters themselves tend to show that there exists an expanding supercluster and/or that $\Lambda > 0$. Several tests of the hypothesis of expansion of clusters are proposed. (auth)

9531 BLACK HOLES OF SMALL MASS. Blair, D. G.; Chanmugam, G.; Drilling, J. S.; Fay, T. D.; Peters, J. G. (Louisiana State Univ., Baton Rouge). Nature (London); 251: No. 5472, 204-205(20 Sep 1974).

It is thought to be possible that during the initial chaotic conditions in the Universe black holes of small mass, down to 10^{-5}g, may have been formed, and experimental work is suggested by which detection of such black holes may be possible, together with the setting of meaningful upper limits to their number density. A highly sensitive superconducting accelerometer is under construction for use in this work. This instrument will measure the deflection of a magnetically levitated test object against a constraining magnetic field, and should be capable of measuring deflections as small as 10^{-17} cm. In order to detect a black hole of the above type, observation of a differential acceleration of the test mass relative to its support is necessary. It is stated that it is likely that during the early history of the Universe these small mass black holes became concentrated into galaxies with an upper limit space density of $\sim 10^{-23}$ g/cm^3 in the solar neighbourhood. Consideration is given as to whether these black holes could be concentrated within the Solar System through gravitational interaction with a planet such as Jupiter; this could give rise to an even greater number of small mass black holes. The trajectory of a small mass black hole could be roughly estimated by utilizing the uniaxial directional properties of the accelerometer. (UK)

9532 SOME EXACT MODELS OF INHOMOGENEOUS DUST COLLAPSE. Liang, E.P.T. (Center for Relativity Theory, The University of Texas at Austin, Austin, Texas 78712). Phys. Rev. D 10: No. 2, 447-457 (15 July 1974).

Three classes of irrotational—dust—collapse models with high symmetries are studied. The interior collapsing solution is joined smoothly onto an exterior static vacuum. The spherical model is just a generalization of the Oppenheimer—Snyder model. A black hole is formed in this case. The plane—symmetric model turns out to either have negative gravitating mass and bounce, never reaching the singularity, or have no static exterior. In the latter case all we get for the exterior is a Kasner universe. In the cylindrical case, however, we succeed in constructing a model that, starting with initially regular conditions, collapses into the naked singularity of an external static field. (auth)

9533 OBSERVATIONAL BACKGROUND OF TREDER'S GRAVITATION THEORY IN COSMOLOGY AND THE ROLE OF VISCOSITY. Oleak, H. (Deutsche Akademie der Wissenschaften, Babelsberg, Ger.). Astron. Nachr.; 295: No. 3, 107-121(1974).

The observational implications of model universes derived from Treder's field equations are explored. Solutions of the field equations are presented for a zero-pressure model. The model is used for deriving main astronomical quantities including the Hubble parameter, the deceleration factor, the Friedmann time, and the red shift-magnitude relation. It is shown that regular models can also be obtained on the basis of the field equations if one takes into account energy dissipation and considers a realistic medium consisting of matter and radiation. In this case bulk viscosity prevents singularity by generating a large amount of entropy. (IAA)

9534 PRINCIPLE OF CORRESPONDENCE IN COSMOLOGY. I. The Isotropic Cosmos as Newtonian Limit of Relativistic Theories of Gravitation. Treder, H. J. (Deutsche Akademie der Wissenschaften, Babelsberg, Ger.). Astron. Nachr.; 295: No. 1, 1-8(1974). (In German).

Newton's kinematics of the isotropic cosmos is examined, giving attention to a correspondence between the general theory of relativity, Newton's gravitational theory, and special-relativistic field theories. The Hamiltonian functions of the N-particle system are considered along with the potential equation and Einstein's field equations. Newtonian Hamiltonian functions with time-dependent active gravitational masses correspond to modified relativistic theories of gravitation. It is found that a model of the universe obtained on the basis of a relativistic theory of gravitation is consistent in its characteristics and compatible with requirements regarding a correspondence with Newton's theory if a number of parameter relations, which are a consequence of the principles of gravitational theory, are in agreement with the Friedmann equation. (IAA)

Planetary Phenomena

Refer also to abstracts 9433 and 9557.

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 8364 and 9327.

9535 (AD-778997) NIGHTTIME LOWER IONOSPHERE. Strobel, D. F.; Young, T. R.; Meier, R. R.; Coffey, T. P.; Ali, A. W. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 35p. (NRL-MR-2778). NTIS $3.25.

Detailed numerical calculations for the nighttime lower ionosphere are performed to evaluate the quantitative importance of nighttime radiation fields. Models for the intensities of night sky HI 1216, HI 1026, HEI 584, and HEII 304A radiation are presented and the production rates of ion species are calculated. The intensity of the Lyman- and Lyman-radiation fields from terrestrial and extraterrestrial sources is sufficient to maintain the nighttime lower ionosphere at observed electron density levels. Analysis of ion composition data indicates that on winter anomalous days of D-region ionospheric absorption of the E-region is substantially depleted of no molecules. (auth)

9536 (AD-779262) PRELIMINARY REPORT ON THE TRANSPORT AND PRODUCTION OF ENERGETIC ELECTRONS IN AURORAS. Strickland, D. J.; Kepple, P. C. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 24p. (NRL-MR-2779). NTIS $3.00.

A method is described for solving a transport equation for energetic auroral electron fluxes. Selected results are presented for an incident electron flux sharply peaked at 750 eV and isotropic in the downward hemisphere. The results include the energy spectrum of the backscattered flux, downward and upward fluxes at various altitudes, angular distributions of fluxes, and volume production rates. (auth)

9537 (AD-779892) ICE CAP ANALYSIS: MECHANISMS FOR ENERGY DEPOSIT IN THE AURORAL IONOSPHERE. Final Report. Sears, R. D.; Evans, J. E.; Varney, R. N. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). 15 Jan 1974. Contract DNA01-73-C-0224. 63p. (LMSC-D-358174). NTIS $3.75.

The purpose of the investigation is to provide analytical support to the ice cap program with respect to defining the possible sources of energy input to the auroral region ionosphere and their relative importance to the optical emission measurements made during operation ice cap experiments. Topics discussed include: energy deposit by precipitating electrons; Joule heating; and, detection and measurement of wavelike disturbances. (auth)

9538 (AD-779913) JOINT RADAR/SATELLITE EXPERIMENTS AT CHATANIKA, ALASKA. Technical Report No. 1, October 1971–November 1973. Watt, T. M. (Stanford Research Inst., Menlo Park, Calif. (USA)). Dec 1973. 50p. (DNA-3305F). NTIS $3.25.

The results of joint radar/satellite experiments at Chatanika, Alaska are reported. Two types of experiments are described: (1) simultaneous observation of electron-density profiles obtained by incoherent-scatter and topside-sounding techniques, and comparison of the two sets of results; and (2) measurement of electron density and energetic particle flux, and the combination of these measurements to obtain profiles of effective recombination coefficient. The latter experiment (2) was completed and is described in some detail. Values of effective recombination coefficient obtained by this technique compare favorably with results reported elsewhere. (auth)

9539 (AD-781184) ROCKET INSTRUMENTATION FOR ICECAP 73A AURORAL MEASUREMENTS PROGRAM: BLACK BRANT 18.205-1. Report on High Altitude Effects Simulation (HAES). Burt, D. A.; Davis, C. S. (Utah State Univ., Logan (USA). Dept. of Zoology). Feb 1974. Contract F19628-72-C-0255. 149p. (AFCRL-TR-74-0195).

On March 27, 1973 at 0937 GMT, Black Brant A18.205-1 was launched from the Poker Flat research range in Alaska as part of Icecap 73–a continuing auroral measurements program. The payload penetrated a bright, stable auroral arc permitting coordinated, simultaneous measurement of the several auroral parameters. Measurements were made of near infrared emissions (1.6 to 5.4 micrometers), selected visible and ultraviolet emissions, auroral electron fluxes, ion and neutral composition, and ionospheric electron and ion densities and temperatures. Special emphasis was placed on making measurements of infrared emissions in order to increase the knowledge of auroral chemistry and physics and to update predictive computer codes. (GRA)

9540 (AD-781761) D-REGION IONIZATION RATES FOR THE 2 TO 5 NOVEMBER 1969 PCA EVENT AS DETERMINED FROM SATELLITE PROTON FLUX. Swider, W.; Foley, C. I. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 12 Apr 1974. 29p. (AFCRL-ERP-473; AFCRL-TR-74-0190). NTIS $3.25.

D-region ionization rates have been determined from satellite proton spectra as a function of altitude for forty-four instances during the period of 2 to 5 November 1969 polar cap absorption event. The ionization rates were calculated using least square fits to the satellite proton spectra in both energy and rigidity. The combined results provide ionization rates for the event as a function of universal time. (auth)

9541 (AD-783211) EXCITATION OF INFRARED AURORAL EMISSIONS IN COLLISIONS OF H$^+$ AND H WITH N$_2$. Birely, J. H.; Johnson, P. A. (Aerospace Corp., El Segundo, Calif. (USA)). 5 Jul 1974. Contract F04701-74-C-0075. 10p. (SAMSO-TR-74-157). NTIS $3.00.

Cross sections for emission of the N_2^+ (a doublet π(U)–X doublet sigma G$^+$) Meinel (2,0) and the N$_2$ (B triplet π(G)–A triplet sigma U$^+$) first positive (1P) (3,1) bands in 0.5 to 25 keV H$^+$ and H impact on N$_2$ are reported. It is shown that, in a hydrogen aurora, H$^+$ and H impact make comparable contributions to the Meinel band intensity, but that neutral hydrogen impact is the predominant source of 1P emission. The vibrational distribution of N_2^+ formed in 25 keV H$^+$ and H impact with $V' = 2-5$ is shown to be in good agreement with the prediction of a simple, Franck–Condon model. (GRA)

9542 (TT-74-50008) STUDIES IN ATMOSPHERIC ELECTRICITY. Kolokolov, V. P.; Lobodin, T. V. Translated by A. Moscona and H. Olaru from Tr. Gl. Geofiz. Observ.; No. 277, vp(1972). 143p. NTIS $4.75.

Studies in atmospheric electricity include cloud physics, thunderstorms, electric fields, auroras, lightening, and weather modification. (JFP)

9543 (UCRL–76089) JOINT COSMIC/AURORAL X-RAY PANEL. Seward, F. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Oct 1974. 7p. (CONF-740843-4). Dep. NTIS $4.00.

From international conference on x-rays in space; Calgary, Canada (14 Aug 1974).

The problem of low-latitude precipitating electrons having energies in the 10-to 100-keV range in soft x ray experiments is considered. (WDM)

9544 EVIDENCE OF TWO TYPES OF ELECTRON DENSITY IRREGULARITIES IN THE ELECTROJET OVER THUMBA, INDIA. Prakash, S. (Physical Research Lab., Ahmedabad, India); Jain, C. L.; Balsley, B. B.; Greenwald, R. A. J. Geophys. Res.; 79: No. 28, 4334-4336(1 Oct 1974).

A coherent backscatter radar has been installed in Thumba, India (8°31′N, 76°57′E and dip 0°47′S), for studying the instability mechanisms responsible for the electron density irregularities in the equatorial electrojet. The power spectra of the radar echoes from these irregularities confirm the results of Cohen and Bowles (1963) and the later classification by Balsley (1967) into type 1 and type 2 irregularities. The spectra of the type 1 irregularities are relatively narrow and are Doppler-shifted by an amount corresponding to the ion acoustic velocity. The type 2 spectra are considerably broader, although the Doppler shift is variable and less than that of the type 1. The similarity of the electron drift velocity over Thumba, India, and Jicamarca, Peru, determined by this method and the dissimilarity between the total electrojet current over these two locations raises a question regarding the spatial structure of the electrojet current and/or of the irregularities themselves. (auth)

9545 CONJUGATE EXCITATION OF ATOMIC OXYGEN EMISSIONS IN THE FAR ULTRAVIOLET. Holberg, J.; Paresce, F. (California Univ., Berkeley (USA). Space Sciences Lab.). Astrophys. Space Sci.; 30: No. 1, 115-122(Sep 1974).

Rocket observations of far ultraviolet terrestrial airglow emissions in the 1230 to 1450 Å band at night have been carried out from White Sands Missile Range. Three rockets carried 15.4 cm diameter far ultraviolet telescopes to ≈220 km altitude at various times during the night from post sunset to predawn. Post sunset and predawn observations were made when the solar zenith angle at the conjugate ionosphere was ~95° and in both cases positive identification of strong OI, 1304 Å emissions was made. Evidence that in these cases the 1356/1304 intensity ratio was less than 0.2 is presented. Observations made well into the night yielded only an upper limit to the combined OI, 1304, and 1356 Å emissions of 20 Rayleighs, consistent with previous observations and theoretical calculations. These results show that meaningful rocket observations of the cosmic far ultraviolet background can be made only when the solar zenith angle at the conjugate ionosphere of the launch site is larger than 105° or if atomic oxygen emission lines are excluded from the detectors' bandpass. (auth)

9546 ANALYTICAL STUDY OF THE OBLIQUE ECHO MODEL FOR THE TOPSIDE PLASMA RESONANCE. Parkes, E. J. (Strathclyde Univ., Glasgow). J. Plasma Phys.; 12: No. 2, 199-216(Oct 1974).

The oblique echo model for the resonance near the local plasma frequency f_N observed by topside sounders involves the propagation of slow waves away from the sounder, which later return as echoes after reflexion due to an electron density gradient. The model is investigated using the WKB technique introduced by Fejer and Yu. The resulting set of saddle-point equations is solved by a method which can, unlike previous work, be applied to both the "strong" resonance (for which $f_N > f_H$ where f_H is the electron gyrofrequency) and to the "weak" ($f_N < f_H$) resonance. Throughout the calculations, the validity of the approximations made is checked. It is found that the weak resonance solution is not valid for typical topside parameters. For the strong resonance, the electric field of a small pulsed dipole is calculated. Expressions are found for the frequency of the two echoes that are received by the sounder and the frequency of the beating between them. Although these are only strictly valid for times longer than typical observation times, they yield results that agree well with the corresponding results from ray trajectory computations. (auth)

9547 INFLUENCE OF THERMAL PLASMA FLOW ON THE MID-LATITUDE NIGHTTIME F_2 LAYER: EFFECTS OF ELECTRIC FIELDS AND NEUTRAL WINDS INSIDE THE PLASMASPHERE. Park, C.G. (Radioscience Laboratory, Stanford University, Stanford, California 94305); Banks, P.M. J. Geophys. Res. 79: No. 31, 4661-4668 (1 Nov 1974).

Theoretical models of the coupled ionosphere—plasmasphere system have been investigated with respect to processes occurring in the nighttime F_2 layer. It is found that plasma flow from the plasmasphere into the ionosphere has a strong stabilizing influence upon the peak F_2 region ion density N_mF_2 such that for wide ranges of applied east—west electric fields or north—south thermospheric winds there is essentially no change in the maximum density of the F_2 layer (N_mF_2). It is also found that N_mF_2 depends sensitively upon the plasma density of the plasmasphere and upon the neutral hydrogen concentration in the thermosphere. Time—dependent processes have been studied also by using step function electric fields and neutral winds. In the electric field case, squeezing of thermal plasma out of the plasmasphere along a contracting field tube significantly affects N_mF_2. Neutral thermospheric winds, on the other hand, have little effect on nighttime N_mF_2. (auth)

9548 DIFFUSE RADAR AURORA AND THE GRADIENT DRIFT INSTABILITY. Greenwald, R.A. (Aeronomy Laboratory, NOAA, Boulder, Colorado 80302). J. Geophys. Res. 79: No. 31, 4807-4810 (1 Nov 1974).

The plasma fluid equations used by Sudan and his co—workers to explain the small—scale secondary irregularities observed in the equatorial electrojet are applied to the diffuse radar aurora. It is shown that the increased magnitude of the ambient magnetic field in the auroral zone and the decreased ion—neutral collision frequency, due to the higher altitude at which diffuse radar aurora occurs, combine to stabilize secondary two—stream irregularities over the expected range of electron drift velocities and primary irregularity amplitudes. It is also shown that secondary gradient drift irregularities are unstable for electron drift velocities in the vicinity of the ion acoustic velocity and that in addition to primary two—stream irregularities, primary gradient drift irregularities may be generated in the auroral E layer density gradients. These results are used to explain some of the spectral observations of the diffuse radar aurora. (auth)

9549 DIRECT MEASUREMENT OF THE PROPAGATION OF WHISTLER WAVE PACKETS. Baker, D. R.; Hall, T. A. (European Space Research Inst., Frascati, Italy). Plasma Phys.; 16: No. 10, 901-907(Oct 1974).

The group velocity of whistler wave packets was measured in an overdense cylindrical plasma. The phase velocity was measured using c.w. excitation. The waves are excited and received by small antennas which excite and detect an oscillating β field in the plasma. The dispersion relation for whistler waves in a cylindrical plasma is calculated. It is seen that for $\omega < \omega_{ce}/2$, it is necessary to include collisions to account for the experimental results for the real part of the dispersion relation. In the limit of large collisions the dispersion relation goes to the plane wave result. It is found that there exists a range of plasma parameters for which two modes of the whistler waves are excited. The interference of these two modes can complicate the interpretation of various linear and nonlinear wave experiments. It is also shown that whistler waves can be used in an interferometer system to measure plasma density. The results are compared with a microwave interferometer operated in the ordinary mode. (auth)

9550 ANALYTICAL STUDY OF THE OBLIQUE ECHO MODEL FOR THE TOPSIDE UPPER HYBRID RESONANCE. Parkes, E. J. (Strathclyde Univ., Glasgow). J. Plasma Phys.; 12: No. 2, 217-232(Oct 1974).

The oblique echo model for the resonance near the local upper hybrid frequency f_T observed by topside sounders involves the propagation of slow waves away from the sounder, which later return as echoes after reflection due to an electron density gradient. The model is investigated using the WKB techniques introduced by Fejer and Yu. The resulting set of saddle-point equations is solved by a method which can, unlike previous work, be applied to both the "strong" resonance (for which $f_T < 2f_H$, where f_H is the electron gyrofrequency) and to the "weak" ($f_T > 2f_H$) resonance. Throughout the calculations the validity of the approximations made is checked. It is found that the weak resonance solution is not valid for typical topside parameters. A condition is derived for the existence of intercepting ray paths and for the maximum time delay which occurs when they do exist. For the strong resonance the electric field of a small pulsed dipole is calculated. Expressions are found for the frequency of the two echoes which are received by the sounder and the frequency of the beating between them. Although they are only strictly valid for times longer than typical observation times, they yield results that agree well with the corresponding results from ray trajectory computations. (auth)

Effects of Nuclear Detonations

9551 (AD-779906) ORIGIN OF THE SUNSPOT MODULATION OF OZONE: ITS IMPLICATIONS FOR STRATOSPHERIC NO INJECTION. Ruderman, M. A.; Chamberlain, J. W. (Stanford Research Inst., Menlo Park, Calif. (USA)). Apr 1974. Contract DAHC15-73-C-0370. 47p. (SRI-JSR-73-8). NTIS $3.25.

The measured modulation of cosmic rays deposited in the stratosphere over a sunspot cycle produces an oscillating source of stratospheric NO with an 11-year (quasi) period. The resulting modulation of ozone over this period is calculated, and is shown to give good agreement with available measurements of the time lag, the latitude dependence, and the magnitude of cyclic variations of ozone. This correlated modulation is then used to predict the effect on ozone of the injection of NO into the stratosphere from artificial sources, viz., a fleet of supersonic transports and nuclear bomb explosions in the atmosphere. (auth)

Magnetospheric Phenomena

Refer also to abstracts 8523 and 9444.

9552 (AD-779051) ELECTROSTATIC AND ELECTROMAGNETIC TURBULENCE ASSOCIATED WITH THE EARTH'S BOW SHOCK. Rodriguez, P.; Gurnett, D. A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Apr 1974. Contract N00014-68-A-0196-0009. 59p. NTIS $3.75.

The electric and magnetic field spectral densities of plasma waves in the earth's bow shock were measured in the frequency range 20 Hz to 200 kHz using two 16-channel spectrum analyzers on the IMP-6 spacecraft. (auth)

9553 (AD-780276) WAVE—PARTICLE INTERACTIONS IN THE MAGNETOSPHERIC PLASMA. Final report. Schulz, M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 15 Apr 1974. Contract N00014-73-C-0333. 161p. NTIS $5.00.

Contents: Crude approximations to some aspects of three-dimensional magnetospheric dynamics; effect of instabilities on ring current; evaluation of limit on stably trapped particle flux; particle lifetimes in strong diffusion; particle saturation of the outer zone; trapping of particles by waves in a nonuniform plasma; phase-integral approximation of PC-4 eigenfrequencies; necessary conditions for bounce-resonant wave amplification; electromagnetic radiation from a helically phased particle beam; computer simulation of an ion beam antenna; radiation from a line source carrying a traveling wave in a magnetoplasma. (auth)

9554 (TID—26654) TWO ASTROPHYSICAL APPLICATIONS OF KINETIC THEORY; JET STREAM FORMATION THROUGH

INELASTIC COLLISIONS: PLASMA OSCILLATIONS IN THE MAGNETOSPHERE. Baxter, D. C. (California Univ., San Diego (USA)). 1973. 68p. Dep. NTIS $6.50.

Thesis.

The results of observation and analysis of plasma oscillations in the millihertz range in the magnetosphere by ATS-5 are reported. (WDM)

9555 MAGNETOPAUSE OBSERVATIONS AT LARGE GEOCENTRIC DISTANCES. Villante, U. (Univ. Aquila, Italy). Lett. Nuovo Cim.; 11: No. 12, 557-560(23 Nov 1974).

Typical observations of magnetopause structure are shown. It is concluded that at geocentric distances of about 1000 R_E there is still a well defined boundary layer between the geomagnetic tail and the external solar wind. The internal structure of the magnetopause (more or less permeable to the solar-wind particles) is responsible for observed plasma flows which are likely determined by the interconnection rate of interplanetary- and geomagnetic-field lines. (JFP)

9556 OBSERVATION OF SOLAR FLARE, POLAR CAP, AND MAGNETOSPHERE DISTURBANCE. Hakura, Y. (Radio Research Lab., Tokyo). pp 62-67 of International Magnetosphere Study Symposium. Tokyo; Tokyo Univ. (1973). (In Japanese)

From symposium on international magnetosphere study; Tokyo, Japan (21 Jun 1973).

Measurements of the phase and amplitude of vlf radiowaves are good monitors of solar x-ray flares, proton phenomena, and magnetospheric substorms. The results of measurements of the solar proton phenomena and the K_p index of terrestrial magnetism are compared with the variation of phase of waves received at Inubo. The correlation between the phase variation and proton flux is seen. The proton phenomena of F ($E_p > 10$ MeV) ≥ 0.7 protons. cm^{-2}. sec^{-1}. $ster^{-1}$. produces polar cap phase anomaly (PCPA). The radiowaves of GBR-16.0 kH$_z$ are compared with the K index of Kiruna. It is found that the vlf radiowaves passing through auroral bands is a good detector of substorms. As the IMS project, the following measurements are considered: The x-ray flare is detected as sudden phase anomaly and sudden field anomaly; the monitor for the PCPA and the proton phenomena is NAA; the limit of proton invasion can be found by investigating the PCPA; the monitors for the magnetosphere substorm are NAA, GBR, or Aldra, and NWC. (JA)

9557 DIAGNOSTICS OF THE MAGNETOSPHERE AND INTERPLANETARY MEDIUM BY MEANS OF PULSATIONS. Gul'elmi, A. V. (Borok Observatory, Institute of Physics of the Earth, USSR). Space Sci. Rev.; 16: No. 3, 331-345(Sep 1974).

From international association of geomagnetism and aeronomy symposium on micropulsations theory and new experimental results; Kyoto, Japan (Sep 1973).

The possibility of diagnostics of the interplanetary magnetic field using the data of ground observations of Pc3, 4 pulsations is investigated. Both empirical and theoretical foundations of this method are discussed. In the shorter-period range (Pc1, Pi1, Ipdp) the methods of qualitative diagnostics of non-stationary processes in the quiet and disturbed magnetosphere are considered. In conclusion, the problems arising when estimating the amplitude of the hydromagnetic waves in the regions of generation are briefly considered. (auth)

9558 THE CONSEQUENCES OF MICROPULSATIONS ON GEOMAGNETICALLY TRAPPED PARTICLES. Thorne, R. M. (California Univ., Los Angeles (USA). Dept. of Meteorology). Space Sci. Rev.; 16: No. 3, 443-458(Sep 1974).

From international association of geomagnetism and aeronomy symposium on micropulsations theory and new experimental results; Kyoto, Japan (Sep 1973).

Nonadiabatic radiation belt dynamics is largely controlled by interactions between geomagnetically trapped particles and various modes of plasma turbulence. Long-period electric field fluctuations act as a major source mechanism for the inner zone through the process of inward radial diffusion of particles injected into the convection-dominated outer zone. Higher-frequency turbulence provides a major loss mechanism by pitch-angle scattering into the atmospheric loss cone. The wave–particle interactions may take the form of self-induced instabilities or parasitic scattering. Examples of each are given in this review. (auth)

9559 WAVE-PARTICLE INTERACTIONS BETWEEN THE RING CURRENT PARTICLES AND MICROPULSATIONS ASSOCIATED WITH THE PLASMAPAUSE. Nambu, M. (Dept. of Physics, Kyorin Univ. School of Medicine, Miyashita-cho, Hachioji-shi, Tokyo 192, Japan). Space Sci. Rev.; 16: No. 3, 427-442(Sep 1974).

From international association of geomagnetism and aeronomy symposium on micropulsations theory and new experimental results; Kyoto, Japan (Sep 1973).

The drift-wave instabilities likely to occur at and near the plasmapause during the period of magnetospheric disturbances are described. The analysis predicts that the proton cyclotron drift loss-cone wave (non-flute electrostatic mode) grows at and near the plasmapause through the drift cyclotron resonant interactions of the ring current protons. The wave is particularly effective for the turbulent loss of the ring current protons just beyond the plasmapause. In a region just inside the plasmapause the wave is likely to be stabilized by the Landau interaction of the plasmaspheric particles. The unstable wave propagates in opposite directions inside and outside the plasmapause. Accordingly, the proton precipitation pattern would be different in respective regions. The unified loss mechanism of the ring current protons is presented. It is suggested that an ordinary mode instability occurs through the drift resonant interactions with the ring current electrons far beyond the plasmapause. This wave is excited only in a high-β plasma with the conditions that the electron temperature perpendicular to the magnetic field is greater than the parallel temperature and that the temperature gradient has an opposite sign to that of the number density and magnetic field. The frequency and wavelength of the fastest growing wave depend sharply on the temperature anisotropy as well as the strength of the inhomogeneities (in temperature, magnetic field and number density). The fastest growing wave has a period of ~36.9 s under certain conditions. This wave is likely to be an origin of the pitch-angle diffusion of the ring current electrons. (auth)

9560 THE RATIO OF SPECIFIC HEATS FOR POSTSHOCK PLASMAS OF A DETACHED BOW SHOCK: An MHD MODEL. Chao, J.K.; Wiskerchen, M.J. (Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721). J. Geophys. Res. 79: No. 31, 4769-4774 (1 Nov 1974).

The empirical relationship between the standoff distance of a detached bows shock (generated by the flow of a supersonic gas past an impenetrable obstacle), the size of the obstacle, the Mach number of the gas, and the ratio of specific heats has been generalized to include the magnetic field. The value of the ratio of specific heats γ' in the postshock plasma has been calculated in terms of the preshock Alfvenic and sonic Mach numbers and orientation of the magnetic field. For an Alfvenic Mach number equal to or larger than 6 the computed value of γ' from the MHD model agrees with that obtained from the gas dynamic model. However, for an Alfvenic Mach number less than 4, γ' computed from the MHD model is much smaller. The empirical relationship is further generalized by taking into consideration the normal momentum and energy flux due to waves and/or turbulence and/or heat flow in association with high Mach number shocks. The computed value of γ' is substantially modified in comparison with that given by the MHD or the gas dynamic model. For this generalized model the computed γ' can be considered to be a more precise thermodynamic quantity, since the macroscopic parameters of the plasma, such as the magnetic field and momentum and energy flux due to waves and/or turbulence and/or heat flux, have been separated out. Application of this empirical relationship to the earth's bow shock has been given. (auth)

9561 ULF MAGNETIC POWER SPECTRA IN THE MAGNETOSHEATH AND MAGNETOSPHERE. Humble, J.E. (Department of Physics, University of Tasmania, Hobart, Tasmania, Australia); Hedgecock, P.C. J. Geophys. Res. 79: No. 31, 4775-4778 (1 Nov 1974).

Magnetic power spectra parallel and perpendicular to the local magnetic field and in the frequency range 3.3×10^{-4} to 2.6×10^{-3} Hz are reported for both the magnetosheath and the magnetosphere. The measurements were mostly obtained in regions elevated ~50° above the ecliptic plane on the night side of the earth, at geocentric distances between 11 and 35 R_E. The results confirm and extend previous observations. The magnetosheath spectra are flatter than those from the magnetosphere, and in both regions the spectra parallel to the field are steeper than those perpendicular to it. The mean power level in the magnetosheath appears to rise with increasing geomagnetic activity. (auth)

9562 PLASMA AND ENERGETIC PARTICLES IN THE MAGNETOTAIL AT 60 R_E. Chase, L.M. (Space Sciences Laboratory, University of California, Berkeley, California 94720); McGuire, R.E.; McCoy, J.E.; Lin, R.P.; Anderson, K.A.; Hones, E.W. J. Geophys. Res. 79: No. 31, 4779-4786 (1 Nov 1974).

Particle measurements made by the lunar–orbiting Apollo subsatellites have shown that electron energy spectra in the range 0.55–320 keV in the high–latitude magnetotail often fit a power law with an exponent of $\gamma \simeq -3$ and a flux at 1/2 keV of $2-7\times10^5$ el/cm^2 s sr keV. In the magnetosheath, electron energy spectra are similar to the high–latitude magnetotail spectra. In the plasma sheet, electron energy spectra often fit the high–energy tail of a Maxwellian distribution with $E_0 \simeq 200-500$ eV. During times of substorms a number of cases where the plasma sheet appears to thin at onset have been observed. In addition, cases of plasma sheet expansion at onset have also been observed. (auth)

9563 THE ONSET TIME OF MAGNETOSPHERIC SUBSTORMS DETERMINED FROM GROUND AND SYNCHRONOUS SATELLITE RECORDS. Kamide, Y. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701); McIlwain, C.E. J. Geophys. Res. 79: No. 31, 4787-4790 (1 Nov 1974).

The result of the test to determine the onset time of magnetospheric substorms by examining the simultaneous ATS 5 particle and ground magnetic data is reported. It is found that for substorms of great intensity, their onset times inferred from the ground magnetic perturbations and from proton injections into the synchronous orbit coincide within an accuracy of 10 min. For weak and localized substorms, however, there is sometimes no particle injection into the ATS distance. It is suggested that the location of substorm origin in the magnetotail is at a greater geocentric distance for such weak substorms than it is for intense ones. (auth)

9564 FURTHER ASPECTS OF THE PROTON RING CURRENT INTERACTION WITH THE PLASMAPAUSE: MAIN AND RECOVERY PHASES. Williams, D.J.; Lyons, L.R. (Space Environment Laboratory, NOAA/ERL, Boulder, Colorado 80302). J. Geophys. Res. 79: No. 31, 4791-4798 (1 Nov 1974).

Recent storm recovery phase results from Explorer 45 (Williams and Lyons, 1974) show the existence of nearly isotropic proton pitch angle distributions with apparently empty loss cones at high equatorial L values and a transition to a rounded pitch angle distribution at lower L values, the transition altitude decreasing with decreasing energy. These recovery phase results were used to describe the hot—cold plasma interaction in the vicinity of the plasmapause region. It was concluded on the basis of low—altitude loss cone observations that a region of strong plasma turbulence exists during storm recovery phase at altitudes above Explorer 45 apogee (5.24 R_E). We present in this report direct Explorer 45 observations during main phase that are consistent with the observation of the turbulent (full loss cone) region. We also present recovery phase data consistent with outward expansion of the plasmapause region due to refilling from the ionosphere. (auth)

9565 PHASE RELATIONS BETWEEN POLAR MAGNETIC SUBSTORM FIELDS AT THE SURFACE OF A FINITELY CONDUCTING EARTH. Nopper, R.W. Jr.; Hermance, J.F. (Department of Geological Sciences, Brown University, Providence, Rhode Island 02912). J. Geophys. Res. 79: No. 31, 4799-4801 (1 Nov 1974).

Most past studies of polar electrojet morphology have not included consideration of the finite electrical conductivity of the earth. Here we present theoretical calculations based on realistic earth models and show that magnetic disturbance field components measured on the ground are expected to be offset in phase from one another by 10—20 min and from the electrojet by up to 10 min at a period of about 2 hours. These phase shifts are large enough to lead to misinterpretation in studies of spatial motions of the electrojet as well as to affect the temporal correlation between ground—based records and in situ measurements of ionospheric processes. The analysis of a standard magnetogram supports our results. (auth)

9566 ULF PULSATION EVIDENCE OF THE PLASMAPAUSE 3. INTERPRETATION OF POLARIZATION AND SPECTRAL AMPLITUDE STUDIES OF Pc 3 AND Pc 4 PULSATIONS NEAR $L=4$. Lanzerotti, L.J.; Fukunishi, H.; Chen, L. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Geophys. Res. 79: No. 31, 4648-4653 (1 Nov 1974).

Analyses of the wave spectral amplitude and wave polarization characteristics of magnetic pulsations measured at four magnetometer stations near $L=4$ on January 5, 1972, demonstrated that the wave properties in selected frequency bands varied with latitude in a systematic way throughout the day. By using an idealized model of the radial profile of the magnetospheric plasma density a theoretical extension is made to the magnetic pulsation model of L. Chen and A. Hasegawa (1974). The latitude dependence of the wave properties is calculated for locations away from the localized wave source. This paper shows that good agreement is obtained between the plasma wave properties measured near $L=4$ and the theoretical predictions of the Chen and Hasegawa model. (auth)

9567 THE MEASUREMENT OF COLD ION DENSITIES IN THE PLASMA TROUGH. Harris, K.K. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). J. Geophys. Res. 79: No. 31, 4654-4660 (1 Nov 1974).

The cold ion density in the plasma trough region is an important fundamental parameter in the currently proposed mechanisms to describe magnetospheric dynamics. Direct in situ measurements of the cold ion density are generally difficult owing to uncertainties in vehicle potentials and ion temperatures. It is shown that the light ion mass spectrometer (Lims) from Ogo 5 was very successful in acquiring these data and that vehicle potentials appear not to have been a prohibitive factor. The cold ion plasma trough data show a great deal of variability, indicating a strong dependence on the state of the convection electric field; consequently, average values of cold ion densities in the plasma trough may be significantly different from the actual time—dependent values. The local time plot of plasma trough densities at $L=7$ for data acquired over a 1—year period shows the anticipated increase in cold ion density during the daytime and the expected decrease in cold ion density during dusk and early nighttime. This pattern is closely predicted by magnetospheric convection models. An unusual feature of these data is, however, a substantial dip in the cold ion density near local noon. The ionospheric filling of the plasma trough, as deduced from the Lims data, also shows excellent qualitative agreement with that which would be expected from magnetospheric convection models. The average ionospheric H^+ ion flux flowing into the trough region from the base of the flux tube as calculated from these data is found to be approximately 1×10^8 ions/cm^2 s at 1000—km altitude. This average H^+ ion flux is consistent with ionospherically originated H^+ fluxes predicted by the theory of the polar wind. (auth)

9568 TEMPERATURE AND DENSITY STRUCTURE OF THERMAL PROTON FLOWS. Banks, P.M.; Schunk, R.W.; Raitt, W.J. (Department of Applied Physics and Information Science, University of California, San Diego, La Jolla, California 92037). J. Geophys. Res. 79: No. 31, 4691-4702 (1 Nov 1974).

Thermal proton flows along magnetic field lines are an important feature of magnetosphere—ionosphere coupling. In this paper we report the results of a theoretical study of the thermal structure of such flows. The adopted steady state model is based upon O^+, H^+, and electrons with self—consistent solutions for the separate O^+, H^+, and electron temperatures, the O^+ and H^+ densities, and the H^+ drift velocity. Through investigation of a number of parameters affecting the model, the following is shown: (1) Joule heating arising from the flow of H^+ through O^+ preferentially heats H^+, so that the H^+ temperature is substantially greater than the O^+ temperature. (2) Low O^+ densities characteristic of the trough region appear to give high H^+/O^+ temperature ratios. (3) Typical O^+ densities characteristic of polar wind flow regions give moderate H^+/O^+ temperature ratios (1.5—3). (4) The Mach number of H^+ outflow is substantially reduced in the present models in comparison with the older fixed temperature calculations. (5) Both the flux and the temperature of H^+ are closely linked to the density of atomic hydrogen and hence to the temperature of the thermosphere. (auth)

9569 THE TEMPORAL AND SPATIAL DEVELOPMENT OF MID—LATITUDE THERMOSPHERIC ELECTRON TEMPERATURE ENHANCEMENTS DURING A GEOMAGNETIC STORM. Raitt, W.J. (Department of Applied Physics and Information Science, University of California, San Diego, La Jolla, California 90237). J. Geophys. Res. 79: No. 31, 4703-4708 (1 Nov 1974).

Measurements are presented of thermospheric electron temperatures made by a Langmuir probe mounted on the polar—orbiting satellite Esro 1 before, during, and after the geomagnetic storm of October 31 to November 1, 1968. The data cover a complete time sequence over a period of 9 days while the satellite covered the altitude range 280—1500 km and remained in the noon/midnight local time zones. The data clearly show the development of enhanced temperatures at mid—latitudes associated with stable auroral red arcs in the midnight time zone, trace the latitude dependence of the heating during the progress of the storm, and show the persistence of the zone of elevated temperatures after the magnetic activity has declined. The heating of electrons in the noon time zone is not observed to follow the same pattern as that in the midnight time zone. (auth)

9570 THEORY OF THE NONLINEAR SPECTRUM OF THE GRADIENT DRIFT INSTABILITY IN THE EQUATORIAL ELECTROJET. Rognlien, T.D.; Weinstock, J. (Aeronomy Laboratory, NOAA, Boulder, Colorado 80302). J. Geophys. Res. 79: No. 31, 4733-4746 (1 Nov 1974).

A set of nonlinear coupled differential equations is derived from the fluid equations to describe the two—dimensional nonlinear behavior of the gradient drift instability. The divergence of the nonlinear electron flux, large only if more than one spatial dimension is considered, is identified as the dominant nonlinearity. This term causes saturation of the instability and cascading of energy to smaller wavelengths. Saturated amplitudes and spectra of density and electric field fluctuations are calculated, and both analytical and numerical results are given. Applying the results to nighttime rocket observations in the equatorial electrojet yields the observed density fluctuations of $\sim 10\%$ and also reproduces the observed steepening of the density wave form in the vertical x direction. The nighttime density spectrum is found to be dominated by irregularities that vary only in this x direction. (auth)

9571 ULF PULSATION EVIDENCE OF THE PLASMAPAUSE 2. POLARIZATION STUDIES OF Pc 3 AND Pc 4 PULSATIONS NEAR $L=4$ AND AT A LATITUDE NETWORK IN THE CONJUGATE REGION. Fukunishi, H.; Lanzerotti, L.J. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Geophys. Res. 79: No. 31, 4632-4647 (1 Nov 1974).

The detailed nonstatistical study of H. Fukunishi and L. J. Lanzerotti

(1974) of magnetic pulsations observed on January 5, 1972, is continued in this paper with a thorough examination of the polarization characteristics of Pc 3 and Pc 4 frequency pulsations. The sense of wave polarizations clearly confirms the conclusions of Fukunishi and Lanzerotti that Pc 3 and Pc 4 pulsations near L=4 on this day originate in narrow latitude ranges, the Pc 4 events probably being excited inside the plasmapause and the Pc events probably being excited outside the plasmapause. The phase characteristics of the individual wave trains suggest a long wavelength in the azimuthal direction. By using conjugate data it is concluded for the first time that both the Pc 3 and Pc 4 waves observed near L=4 can be characterized as odd mode standing Alfvén waves. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 9263.

9572 (COO–2425-1) STUDY OF ELECTRON AND UV SURFACE PHOTON INTERACTIONS. Progress Report, March 1, 1974–February 28, 1975. Lichtman, D. (Wisconsin Univ., Milwaukee (USA)). 1974. Contract AT(11-1)-2425. 14p. Dep. NTIS $4.00.

The main electron-induced desorption system was considerably modified. A new gas-phase RGA has replaced the old one, increasing the sensitivity for neutral detection by about 10^5. Special electron guns and control units were designed and constructed to enable experiments on E.I.D. over the energy range 0 to 20 keV. A special ion gun was constructed and added to the system to allow for sputter-cleaning of samples and to enable one to perform secondary ion mass spectroscopy as well. Some preliminary experiments on electron-induced H^+ and F^+ from stainless steel over the temperature range of -196 C to +300 C show a considerable cross section ($\approx 10^{-18} cm^2$) and a definite correlation between the two desorbing ion signals. In the photodesorption work, measurements are being made on zinc oxide since it is presently believed that photodesorption is related to semiconductor substrates. Photodesorption occurs readily from zinc oxide substrate and specific data were taken on photodesorbing oxygen (O), carbon dioxide, carbon monoxide, hydrogen etc. Preliminary results indicate cross sections for photodesorption of approximately $10^{-17} cm^2$ for O and approximately $10^{-19} cm^2$ for CO_2. Measurements on photoconductivity show changes, some of which seem to be related to gas adsorption and desorption. (auth)

9573 SEEDED SUPERSONIC ALKALI ATOM BEAMS. Larsen, R.A.; Neoh, S.K.; Herschbach, D.R. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). Rev. Sci. Instrum. 45: No. 12, 1511-1516 (Dec 1974).

A seeded supersonic beam source for alkali atoms is described which provides velocities up to ~ 5 km/sec. Potassium or rubidium vapor at ~ 0.02 to 0.2 Torr is mixed with a diluent gas of H_2, He, or Ar at ~ 800 Torr and expanded through a pinhole nozzle. The beam properties are found to compare well with the simple theory of isentropic expansions. Typically, the alkali flux is ~ 10^{16} atoms sr^{-1} sec^{-1} and the velocity spread is ~ 8% (FWHM). (auth)

9574 REFLECTION OF CLUSTERS OF HELIUM, HYDROGEN, AND NITROGEN AS FUNCTION OF THE REFLECTOR TEMPERATURE. Gspann, J.; Krieg, G. (Institut für Kernverfahrenstechnik der Universität und des Kernforschungszentrums Karlsruhe, 75 Karlsruhe, Germany). J. Chem. Phys. 61: No. 10, 4037-4047 (15 Nov 1974).

Clusters of helium, hydrogen, and nitrogen are reflected at a polished stainless steel plate at temperatures ranging from 80 to 550 K. The incident clusters contain on the average about 1.5×10^5 atoms of helium or molecules of hydrogen or 10^4 molecules of nitrogen, as measured by time–of–flight mass spectrometry. The angular distributions of the average sizes, the velocities, and the molecular intensities of the reflected cluster beams show that in the investigated range of reflector temperatures the reflection of the helium clusters corresponds to the hydrogen cluster reflection at higher reflector temperatures while the nitrogen cluster reflection corresponds to the hydrogen cluster reflection at lower reflector temperatures. The transition between the two regimes of reflection as observed with hydrogen clusters is marked by an optimum reflector temperature leading to a maximum intensity of the reflected beam, a minimum loss of clustered material, and a distinct angular separation of incident cluster sizes. At a grazing incidence angle of 84.3° the measured optimum reflector temperature for the hydrogen cluster reflection is 215 K and increases with decreasing angle of incidence. The two regimes of high–temperature and low–temperature reflection of clusters exhibit close phenomenological relationship to the regimes of thermal and structure dominated scattering of atoms from single crystal planes. In both cases the transition region is characterized by a maximum angle of reflection and a minimum divergence of the reflected beam. The features of high–temperature cluster reflection are explained by a semiempirical model based on the evaporation recoil of the cluster molecules ablating after contact with the comparatively hot reflector surface. (auth)

9575 GENERALIZED LANGEVIN EQUATION APPROACH FOR ATOM/SOLID–SURFACE SCATTERING: COLLINEAR ATOM/HARMONIC CHAIN MODEL. Adelman, S.A.; Doll, J.D. (Department of Chemistry, State University of New York, Stony Brook, New York 11794). J. Chem. Phys. 61: No. 10, 4242-4245 (15 Nov 1974).

Zwanzig's approach to inelastic atom/harmonic chain scattering is recast in a form which suggests generalization to atomic collisions with real solid surfaces. We reduce the infinite set of equations of motion for the impinging atom and harmonic chain to a pair of equations of motion. These equations describe the collision of the incident particle with a generalized Langevin oscillator. The first and second fluctuation–dissipation theorems for the Langevin oscillator are verified, and their implications for the scattering process are discussed. (auth)

9576 ELECTRON IMPACT IONIZATION OF INERT GASES. Khare, S. P. (Univ. of Western Ontario, London); Padalia, B. D.; Nayak, R. M. Can. J. Phys.; 52: No. 18, 1755-1758(15 Sep 1974).

Electron impact total ionization cross sections of neon, argon, krypton, and xenon were calculated for the electron impact energy varying from threshold to 20 keV. The method of Khare and Padalia, modified to include approximately the effect of multi-ionization, was employed. The results are in fair agreement with the experimental data. (auth)

9577 SOME PROBLEMS OF AN ION-ELECTRON EMISSION. Dorozhkin, A. A.; Mishin, A. N.; Petrov, N. N. (Leningradskij Politekhnicheskij Inst. (USSR)). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 2, 249-253(Feb 1974). (In Russian).

For english translation see the journal Bull. Acad. Sci. USSR, Phys. Sci.

Although many characteristic lines of the ion-electron emission of metals are already established, there is still a series of questions connected with this phenomenon impossible to answer at present. Among these are the dependence of the kinetic expulsion of electrons on the charge of the nuclei of the target atoms, the nature of the ejection of electrons by molecular ions, the dependence of the coefficient of potential ejection of electrons on the kinetic energy of the primary particle, and the characteristics in the energy spectra of the ejected electrons. Some of the work carried out at the Leningrad Polytechnical Institute on these questions are summarized. (tr-auth)

9578 ON THE ORIGIN OF ION-INDUCED AUGER ELECTRON EMISSION FROM METALS. Viaris de Lesegno, P.; Rivais, G.; Hennequin, J.-F. (C.N.R.S., Laboraoire P.M.T.M., Universite Paris-Nord, 93206 Saint-Denis, France). Phys. Lett., A; 49: No. 3, 265-266(9 Sep 1974).

Auger electron emission by ion bombardment of solids originates from two kinds of collision: asymmetric collisions of the incident particles with the target atoms and symmetric collisions of the target atoms between themselves. Their relative contributions for Auger emission are discussed. (auth)

9579 A SUPERSONIC SECONDARY BEAM NEUTRALIZER FOR LOW ENERGY ION BEAMS. Yencha, A. J. (State Univ. of New York, Albany (USA)); Leroy, R. L. (Noranda Research Centre, Pointe Claire, Quebec (Canada)); Durana, S. (Illinois Univ., Urbana (USA). Dept. of Chemistry); Wolfgang, R. (Yale Univ., New Haven, Conn. (USA). Dept. of Chemistry). J. Mass Spectrom. Ion Phys.; 14: No. 4, 401-413(Aug 1974).

A compact, cryogenically cooled, supersonic molecular beam unit is described, which is suited to the neutralization of ion beams having energies as low as 2 eV. Three criteria govern the secondary beam design: it must have sufficient divergence to encompass the primary ion beam, must be sufficiently intense to give the required degree of neutralization, and must be well enough directed that a negligible number of secondary beam neutral molecules leave the crossed beam chamber, or are adsorbed on its entrance and exit holes. These criteria are formulated into four generalized design equations. A solution of these equations for a particular experimental situation is illustrated, and a supersonic beam neutralizer based on this solution is described. Characterization of this instrument shows good agreement with the design requirements. (auth)

9580 ATOMIC SPECTROSCOPY AS A DIAGNOSTIC TOOL IN ION-BEAM CONTAMINATION PROBLEMS. Doorn, S.; Foster, C.; Hoogkamer, T.; Roukens, H.; Saris, F. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Nucl. Instrum. Methods; 120: No. 2, 371-373(1 Sep 1974).

A 140 keV Si^+ beam has been analyzed for the abundance of contaminating beams by means of spectroscopy of optical excitation in gas-phase collisions. (auth)

Atomic and Molecular Properties

Refer also to abstracts 9611, 9665, 10085, and 10089.

9581 (NBS-SPEC.PUBL-320(Suppl. 2)) BIBLIOGRAPHY ON ATOMIC TRANSITION PROBABILITIES, JULY 1971–JUNE 1973. Fuhr, J. R.; Wiese, W. I. (National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). Nov 1973. 63p. GPO $0.95.

This is the second supplement to the NBS Special Publication 320. "Bibliography on Atomic Transition Probabilities," and it covers the most recent literature on the subject from July 1971 through June 1973. The papers are arranged according to elements and stages of ionization, and the method employed and classification of transitions are indicated for each reference. Only articles on discrete transitions, both allowed and forbidden, are listed. Papers containing data for many elements within isoelectronic sequences are collected separately in front of the list in order to keep this bibliography to a reasonable size. Also included is a selected list of new papers dealing with the subject of atomic transition probabilities from a general point of view. (auth)

9582 ADIABATIC CORRECTION TO THE VAN DER WAALS WELL DEPTH OF He_2. Kleinman, L.I.; Wolfsberg, M. (Department of Chemistry, University of California, Irvine, California 92664). J. Chem. Phys. 61: No. 10, 4366-4367 (15 Nov 1974).

Adiabatic corrections to the van der Waals potential for ^4He and $^4He_2$ are calculated. The correction for He_2 is very close to twice that of two separated He atoms so that the effect of the adiabatic correction upon the energy difference between He_2 and two separated He atoms is negligible. (AIP)

9583 VIBRATIONAL RELAXATION OF $n-H_2$ BY ^4He AND ^3He IN THE RANGE 450–60°K. Audibert, M.M.; Joffrin, C.; Ducuing, J. (Laboratoire d'Optique Quantique, C.N.R.S.—Ecole Polytechnique, 91120 Palaiseau, France). J. Chem. Phys. 61: No. 10, 4357-4358 (15 Nov 1974).

The rates of vibrational de—excitation of $n-H_2$ by ^4He and ^3He have been measured in the temperature range 60—450°K using two—photon Raman excitation and a Schlieren detection technique. The agreement with theoretical values is poor in this temperature range. (AIP)

9584 COPLANAR AND COLLINEAR QUANTUM MECHANICAL REACTIVE SCATTERING: THE IMPORTANCE OF VIRTUAL VIBRATIONAL CHANNELS IN THE $H + H_2$ EXCHANGE REACTION. Kuppermann, A.; Schatz, G.C.; Baer, M. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91109). J. Chem. Phys. 61: No. 10, 4362-4363 (15 Nov 1974).

Accurate quantum mechanical calculations have been performed for the coplanar $H + H_2$ exchange reaction, using sufficient rotational and vibrational basis functions in the close—coupling expansion to insure convergence. These calculations are repeated with a converged rotational basis set but only one vibrational basis function. The vibrationally—converged and one—vibration results differ substantially for the coplanar as well as the collinear reaction, indicating the crucial role played by virtual vibrational channels. (AIP)

9585 SPECTRUM AND ENERGY LEVELS OF DOUBLY IONIZED EUROPIUM (Eu III). Sugar, J. (National Bureau of Standards, Washington, D.C. 20234); Spector, N. J. Opt. Soc. Am. 64: No. 11, 1484-1497 (Nov 1974).

The spectrum of Eu III obtained with a 6 A sliding—spark discharge has been measured from 2000 A to 9000 A. Of the 890 spectral lines observed, one—third are classified in an energy—level scheme consisting of 104 excited levels. These belong to the $4f^7$ configuration and to the $4f^6(^7F)5d$, $4f^6(^7F)6s$, and $4f^6(^7F)6p$ subconfigurations. Except for $4f^7$, calculations of these configurations with least—squares—adjusted parameters were carried out. A reasonably suitable truncation for the energy matrices of each configuration was found. (auth)

9586 MOLECULAR BEAM SCATTERING. Conference Held At London, England, April 16–18, 1973. Faraday Discussions of the Chemical Society, No. 55. London; Chemical Society (1973). 413p. (CONF-730452-). £ 5.50.

The conference included 23 papers, one of which was abstracted previously in NSA as: 28: 19449. Separate abstracts were prepared for 19 papers. Other papers were outside the scope of NSA. (JFP)

For abstracts of individual papers see: 9616–9634.

9587 FUNDAMENTAL ABSORPTION BAND OF HD. Bejar, J.; Gush, H. P. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 52: No. 17, 1669-1671(1 Sep 1974).

The fundamental rotation-vibration band of HD was resolved in the gas at 1 atm pressure. The line width appears to be totally due to the Doppler effect and equals 0.026 cm^{-1}. The transition dipole moment was calculated from the intensities of lines in the R branch: it is found to vary from 4×10^{-5} D for J = 0 to 7×10^{-5} for J = 4. (auth)

9588 FERMI HOLE IN ATOMS. Boyd, R. J.; Coulson, C. A. (Oxford Univ.). J. Phys., B (London); 7: No. 14, 1805-1816(1 Oct 1974).

A new definition of the Fermi hole in many-electron systems is provided in terms of the distribution function $f^{\alpha\alpha}(r_{12})$ (also $f^{\beta\beta}(r_{12})$ for spin β) of the interelectronic distance for electrons with parallel spins. By analogy with the Coulomb hole, the Fermi hole is defined as the difference between the values of $f^{\alpha\alpha}(r_{12})$ derived from the Hartree-Fock and the Hartree wave functions. This definition, unlike previous ones, provides a simple picture of the Fermi hole as a function of r_{12}. By assuming that the Hartree and Hartree-Fock orbitals are identical, an analytical formula is derived for the Fermi hole. Explicit calculations are presented for the 2^3S state of He and the ground state of Be. It is observed that the Fermi hole is remarkably similar in these two cases; and that the effects of Coulomb correlation are more long-ranged than those of Fermi correlation. Comparison of the Fermi holes with the corresponding Coulomb holes leads to several interesting observations. Calculations are also presented for $f(r_{12})$ and two of its components, $f^{\alpha\alpha}(r_{12})$ and $f^{\alpha\beta}(r_{12})$, in the Be ground state. These components resemble the distribution function $f(r_{12})$ in the 1s2s excited states of He. (auth)

9589 AUTO-IONIZATION OF THE FINE STRUCTURE OF X-RAY ABSORPTION EDGES. Ungar, T. (Lorant Eotvos Univ., Budapest). Magy. Fiz. Foly.; 22: No. 3, 213-240(1974). (In Hungarian).

A new model, designated as the "auto-ionization model" was developed to clarify the hyperfine structure of x-ray absorption edges. It is based on the assumption that the absorption coefficient is proportional to the transition probability of the excited electron. The photoionization due to the x-ray photon is a rapid perturbation, which may be described by the so-called "sudden" approximation, in which the electrons of the excited atom are ionized with a finite probability, resulting in autoionization. The transition probability of the excited electron is determined by the multiply charged positive ion thus generated. The absorption is large in the case of the excited electron in a permitted state of the positive ion and is small if the transition cannot take place. The theory was checked by examining experimentally the K absorption edge of molybdenum in the pure metal and in several oxides and by studying hyperfine structures from data in the literature. The study revealed that the new model is universally applicable. (Doctoral dissertation, 42 references). (TTT)

9590 RESONANT MULTIPHOTON EXCITATION OF ATOMIC LEVELS IN A STRONG ELECTROMAGNETIC FIELD. Zaretskii, D. F.; Krainov, V. P. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz.; 67: No. 4, 1301-1305(Oct 1974). (In Russian).

Multiphoton excitation of discrete atomic levels in a low frequency electromagnetic field is considered within the framework of an adiabatic approximation equivalent to the quasiclassical method for the problem of reflection above the barrier. It is found that in the case of a real atom the structure of the transition probability qualitatively is very similar to that for the case of a two-level system. Numerical calculations are presented for transitions between discrete hydrogen atom states. It is concluded that even in weak fields perturbation theory for the process under consideration may be invalid. In strong fields the cross sections for resonant multiphoton excitation greatly exceeds that predicted by perturbation theory. (auth)

9591 SPECTRUM OF DOUBLY IONIZED PRASEODYMIUM FROM 2107 A TO 10716 A. Sugar, J. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand.; 78A: No. 5, 555-593(1974).

Wavelengths, relative intensity estimates, and classifications of the spectral lines of doubly ionized praseodymium (Pr III) in the range of 2107 to 10716 Å are given. About 4400 lines are included of which some 2500 are classified. (auth)

9592 CALCULATIONS OF POTENTIAL ENERGY SURFACES IN THE COMPLEX PLANE.IV. AB INITIO SURFACES FOR H_3^+. Jaffe, R.L.; Morokuma, K.; George, T.F. (Department of Chemistry, The University of Rochester, Rochester, New York 14627). J. Chem. Phys. 61: No. 11, 4717-4725 (1 Dec 1974).

Ab initio LCAO—MO—CI calculations are reported for selected geometries of H_3^+ in the vicinity of the real—valued avoided intersection and complex intersection. The complex energy difference between the two lowest singlet surfaces is compared to the corresponding DIM values. In addition, the effect of polarization functions in the basis set is investigated, and atomic orbital electron populations for the complex CI wavefunction are determined. (auth)

9593 RADIO FREQUENCY INDUCED D-F-TRANSITIONS IN THE n = 4 STATE OF He^+. Elbofner, A. (Tuebingen Univ. (F.R. Germany)). Phys. Lett., A; 49: No. 4, 335-336(23 Sep 1974).

R.f. induced transitions between 4D- and 4F-Zeeman sublevels in He^+ were detected. The signal amplitudes did not agree with theoretical predictions. An indirect experimental value of (15.2 ± 1.5) MHz for the $D_{1/2}$-$F_{1/2}$ shift was obtained (theory: 13.9 MHz). (auth)

9594 HYPERFINE STRUCTURE INVESTIGATIONS IN Dy I WITH THE ATOMIC BEAM MAGNETIC RESONANCE METHOD. Ferch, J.; Dankwort, W.; Gebauer, H. (Bonn Univ. (F.R. Germany). Inst. fuer Angewandte Physik). Phys. Lett., A; 49: No. 4, 287-288(23 Sep 1974).

The hyperfine structure of the ground state configurations $4f^{10}6s^2$ of Dy I was studied, and the nuclear ground state magnetic dipole moments of ^{161}Dy and ^{163}Dy were measured with the atomic beam magnetic resonance method. (auth)

9595 AB INITIO INTERMOLECULAR ENERGIES BETWEEN Li^+ AND H_2 NEAR THE VAN DER WAALS MINIMUM: COMPARISON BETWEEN A PERTURBATIVE PROCEDURE AND AN SCF SUPERMOLECULE TREATMENT. Kochanski, E. (Strasbourg-1 Univ., 67 (France)). Chem. Phys. Lett.; 28: No. 4, 471-476(15 Oct 1974).

The electrostatic, exchange, polarization, and dispersion energies are computed without using the multipole expansion. It is seen that the overlap between the orbitals of the interacting molecules must be taken into account to describe qualitatively the first order term. The neglect of overlap in the polarization term overestimates the attractive energy around the van der Walls minimum. An interpretation of the polarization phenomena in terms of molecular orbitals is proposed. The results are compared with SCF calculations and the use of small basis sets is considered. (auth)

9596 CONFIGURATION INTERACTION STUDY OF H_2 USING A MODIFIED SLATER-TYPE ORBITAL. Leclerc, J. C. (Liege Univ. (Belgium). Chem. Phys. Lett.; 28: No. 4, 546-547(15 Oct 1974).

A non-standard 1s basis function, $\chi = (1 + ar^2) \exp(-\xi r)$, is used to approximate the ground state of the hydrogen molecule in a configuration interaction framework and using numerical integration over MO's. Results are compared to the traditional 1s STO. (auth)

9597 MEASUREMENTS OF THE DISSOCIATIVE RECOMBINATION OF H_3^+ IONS. Peart, B.; Dolder, K. T. (Univ. of Newcastle upon Tyne, Eng.). J. Phys., B (London); 7: No. 14, 1848-1952(1 Oct 1974).

An inclined beam technique was used to obtain cross sections for the dissociative recombination of H_3^+ with electrons for energies E between 0.38 and 4.0 eV. The ions were formed in a source which has been shown to produce H_3^+ with negligible internal energy. The cross section is 1.03×10^{-16} cm^2 at 1 eV and varies as $E^{-0.87}$. There is excellent accord between these results and those which Leu et al., (Phys. Rev.; A8: 413-9(1973)) obtained at thermal energies by a microwave afterglow technique. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

9598 (AD-783774) POSITRONIUM: A REVIEW OF THE CALCULATIONS. Stroscio, M. A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 3 Jun 1974. 33p. (AFCRL-TR-74-0248; AFCRL-ERP-476). NTIS $3.00.

For typical magnetospheric densities, free positrons have a lifetime of between one million and one trillion seconds. A portion of the injected positrons undergo free annihilation and a portion form positronium. Results are given of the theoretical calculations of positronium properties without presenting the intermediate steps that depend on a knowledge of quantum electrodynamics. A review is given of the calculations of positronium state decay rates, energy levels, and external field behavior. Theoretical results are compared with only the latest experimental results. The coverage is substantially complete from the pre-experimental years (1930 to 1950) to the present (1974). Emphasis is placed on stating final theoretical results and giving references to original work rather than giving a step-by-step account of the calculations. (GRA)

9599 (JINR-E6-8127) EMISSION OF SHIFTED ELECTRONIC X RAYS FROM MUONIC URANIUM ATOMS. Arlt, R.; Fromm, W. D.; Gansorig, D.; Krogulski, T.; Ortlepp, H. G.; Polikanov, S. M.; Sabirov, B. M.; Schmidt, U.; Schneuwly, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The electronic x-ray lines from muonic uranium atoms were observed. These lines have occurred to be shifted on some hundreds of electronovolts respectively to characteristic x-rays of photoactinium. One of possible experiments is incomplete screening one charge unit of the nucleus by muon in its orbits. (auth)

9600 (JINR-P14-8050) STRUCTURE OF MESOROENTGEN SPECTRA OF Li AND LiH. Zinov, V. G.; Konin, A. D.; Pokrovskii, V. N.; Ponomarev, L. I.; Sneuly, H.; Yutlandov, I. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

An investigation was made of muonic K_x-ray intensities of Li in the form of metal and lithium hydride. Such a choice of targets makes it possible to follow the features of the population of np-states in the simplest atomic and molecular compounds. The experiments were run on the mesic channel of the Dubna synchrocyclotrob with 90-MeV/c negative muon beam. The experimental lay-out is shown. The muonic x-rays were detected by a Ge(Li) detector of 2.4 cm^3 volume and about 600 eV resolution in the 15 to 25 keV region. The relative intensities of $np \rightarrow 1s$ transitions in Li and LiH targets are given in the table. It should be noted that the errors listed are in all the cases the statistical ones (resulting from the computer processing of spectra). For LiH several theoretical estimates are also given which were obtained by some simplifying assumptions. The comparison with experimental results shows the very important role of the muon initial distribution ρ (l) as well as the predominant population of levels with low l. This appears to be associated with the possibility of adiabatic capture of muons in hydrides. This conclusion seems to be confirmed by the ratio of ratios $R = I(np \rightarrow 1s)/I(2p \rightarrow 1s)$ for LiH and Li targets. (auth)

9601 A SEARCH FOR POSITRONIUM LYMAN-α RADIATION. Dahm, A. J.; Eck, T. G. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Physics). Phys. Lett., A; 49: No. 3, 267-268(9 Sep 1974).

A search was made for positronium Lyman-α radiation from positrons stopped in liquid helium. It is concluded that less than 1 in 30,000 of the positrons yields a Lyman-α photon. This represents a reduction in the upper limit for Lyman-α emission by a factor of 15. (auth)

9602 NARROWING AND FREQUENCY TUNING OF POSITRONIUM ANNIHILATION LINE BY LASER FIELD. Letokhov, V. S. (AN SSSR, Moscow. Inst. Spektroskopii). Phys. Lett., A; 49: No. 4, 275-276(23 Sep 1974).

A new approach to obtaining narrow and tunable spectral lines of positronium annihilation radiation ($\hbar\omega_\gamma = 0.511$ MeV) is suggested based on the conversion of orthopositronium atoms with a certain velocity of motion to the parapositronium under the effect of laser radiation and magnetic field. (auth)

9603 POSITRON ANNIHILATION IN LIQUID MERCURY. Burton, L. D.; Huang, W. F. (Louisville Univ., Ky. (USA)). Phys. Lett., A; 49: No. 4, 323-324(23 Sep 1974).

A positron wave function was calculated for a vacancy and applied to the angular correlation data of liquid mercury. The results indicate that 19% of all annihilations occur at vacancy sites. (auth)

9604 PART I. OBSERVATION OF A QUADRATIC TERM IN THE HFS PRESSURE SHIFT FOR MUONIUM AND A PRECISE DETERMINATION FOR $\Delta\nu$. Part II. Behavior of Positive Muons in Liquid Helium. Crane, T. W. New Haven; Yale Univ. (1974). 143p. University Microfilms Order No. 74-25,730.

Thesis (Ph. D.).

Part I: A precise value for the muonium (μ^+e^-) ground state hyperfine structure interval ($\Delta\nu$) provides a test of the theory of the muon as a "heavy electron." Alternatively, a value for $\Delta\nu$ together with the muon moment can be used to determine the fine structure constant α. Also $\Delta\nu$ is useful in determining the contribution of the proton structure to the hyperfine structure (hfs) interval of hydrogen. An important factor which influences the accuracy of the determination of the ground state hfs interval of muonium ($\Delta\nu$) is the hfs pressure shift caused by collisions of the muonium atom with the inert stopping gas in which muonium is formed. The research involved includes measurements of the hfs interval by microwave resonance techniques at a very weak magnetic field (~10 mG) in a gaseous argon target at the lowest pressures at which acceptable counting rates could be obtained (10 and 15 atm). These low pressure data when combined with earlier work at higher pressures, yield a value of $\Delta\nu$ of 4 463.308(11) MHz and the first conclusive evidence for a quadratic term in the dependence of $\Delta\nu$ on gas density. Part II: A study of positive muons stopped in liquid helium was made with the muon beam available at the NASA Space Radiation Effects Laboratory (SREL). A scintillating liquid helium target was used in searches for free muon precession, for muonium Larmor precession, and for depolarization of the muon spin. For the precession measurements the direction of the magnetic field was transverse to the incident muon spin and the field strength was varied between 4 and 80 gauss. And for the depolarization measurement, longitudinal magnetic fields between 1 and 4 gauss were used. Data were obtained at 4.2°K and below the lambda point at 2°K where the superfluid component was 40 percent. A small fraction of the data was also obtained for cold (≥4.2°K) helium gas with transverse magnetic fields of 4 and 8 gauss. It was found that muons stopped in liquid helium both above and below the lambda point behave as free muons. There was no muonium formation (<2%) and no depolarization of the muon spin (depolarization time >20 μsec). The data for muons stopped in cold helium gas indicated the same behavior. The low value for muonium formation is consistent with experimental results and theory for hydrogen charge capture and ionization cross sections in helium gas. (Diss. Abstr. Int., B)

Collision Phenomena

Refer also to abstracts 8232, 9584, 9597, and 9669.

9605 (COO-3403-9) ANISOTROPIC INTERMOLECULAR INTERACTIONS AND ROTATIONAL ORDERING IN THE SOLID MOLECULAR HYDROGENS. Progress Report No. 9, November 1, 1973–September 30, 1974. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-3403. 104p. Dep. NTIS $8.25.

A summary of research is given on the behavior of solid deuterium in the rotationally ordered state and the experiments were, in the main, designed to provide information on the rotational excitation or libron spectrum of the molecular crystal. (JFP)

9606 (LBL-3351) STUDIES OF THE DISSOCIATION FRAGMENTS OF N_2 AND THE g_J MEASUREMENT OF METASTABLE $^5S_2$ ATOMIC OXYGEN. Incesu, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1974. Contract W-7405-eng-48. 150p. Dep. NTIS $10.50.

Thesis.

The first study described was intended to produce, identify and investigate the magnetic properties of a recently reported $^6S_{5/2}$ metastable state of atomic nitrogen. However, one was unable to demonstrate its existence among the constituents which one could detect in the beam of the discharge products of the nitrogen molecule. In the second study, the atomic beam magnetic resonance method was used to compare the g_J factor of $^5S_2$ state in atomic oxygen with the g_J of $2\ ^3S_1$ state of helium at $H = 4228$ and 3209 gauss. The metastable oxygen and helium atoms were produced in a pulsed discharge source. After traversing the beam apparatus these atoms were detected by the Auger process. Helium and oxygen resonances were accumulated successively. By collecting the data only in a certain interval of the time-of-flight distribution, the ^5S and ^3S states were isolated from other discharge products. With 158 pairs of resonances taken at four relative hairpin and field orientations, the final result is g_J = 2.0020910(10). (auth)

9607 (NBS-SPEC.PUBL-381) BIBLIOGRAPHY OF ION-MOLECULE REACTION RATE DATA (JANUARY 1950–OCTOBER 1971). Sinnott, G. A. (National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). Oct 1973. 66p. GPO $1.00.

A bibliography is presented of papers in the open literature that contain original experimental data on ion-molecule reaction rates or cross sections. Positive and negative ion-molecule and ion–ion reactions are included but not electron impact processes. For papers to be included, the reactants must have been identified and data for kinetic energies below 10 electron volts must have been presented. (auth)

9608 (ORO-4325-12) IONIZATION PHENOMENA. Progress Report, January 1–November 30, 1974. Watson, R. L. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.). 1974. Contract AT(40-1)-4325. 55p. Dep. NTIS $5.75.

Research on ion–atom collisions, trace element analysis by heavy charged-particle-induced x-ray emission, and internal ionization during alpha decay is summarized. A list of publications is included. (JFP)

9609 TARGET DENSITY DEPENDENCE OF MOLECULE–MOLECULE ABSOLUTE TOTAL SCATTERING CROSS SECTIONS. Dehmer, P.M.; Wharton, L. (Department of Chemistry and James Franck Institute, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 61: No. 10, 4209-4216 (15 Nov 1974).

The target density dependence of absolute total cross sections for LiF scattered by CO, CO_2, CHF_3, CH_4, D_2, and Ar was studied at a LiF velocity of 1.5×10^5 cm/sec and a target temperature of 297°K. The experiments were performed under conditions of high angular resolution in order to observe the full quantum mechanical cross section. For the systems LiF–CO, LiF–CO_2, and LiF–CHF_3 there was a substantial variation of observed cross section with density, while for LiF–CH_4, LiF–D_2, and LiF–Ar there was no observable variation. It is shown that the target transmission is the Laplace transform of the cross section distribution function. Information was obtained about the distribution of cross sections as a function of the internal state of LiF by fitting model distributions to the data. For the lower LiF rotational states the LiF–CO and LiF–CO_2 cross sections are dominated by the dipole–quadrupole interaction and are determined at the outermost impact parameters by processes inelastic in the rotation of LiF, and inelastic and/or elastic in the targets CO and CO_2; for the higher LiF rotational states the total cross section is determined mainly by elastic processes and is therefore dominated by induction and dispersion interactions. The dipole–quadrupole scattering effect, so important in microwave line broadening theories, thus has been identified in experiments of this type. For LiF–CHF_3 the largest total cross sections are determined by dipole–dipole inelastic scattering. For those targets which showed no pressure dependence (Ar, D_2, and CH_4) the standard deviation of the cross sections was less than ~15 percent of the mean as determined by the accuracy of the experiments and the range of target densities used. This is consistent with the symmetry of the interaction and the possible degree of anisotropy. No rotational inelasticity could be inferred for these targets. A theoretical analysis of the distribution of cross sections based on dipole–quadrupole and dipole–dipole scattering processes is presented. Various fitted models for the distribution of cross sections can be evaluated in the light of these analyses. (auth)

9610 ELECTRON–IMPACT EXCITATION OF THE LOW–LYING ELECTRONIC STATES OF FORMALDEHYDE. Chutjian, A. (Physics Section, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). J. Chem. Phys. 61: No. 10, 4279-4284 (15 Nov 1974).

Electron–impact excitation has been observed at incident electron energies of 10.1 and 20.1 eV to the first five excited electronic states of formaldehyde lying at and below the $^1B_2$ state at 7.10 eV. These excitations include two new transitions in the energy–loss range 5.6–6.2 eV and 6.7–7.0 eV which have been detected for the first time, either through electron–impact excitation or photon absorption. The differential cross sections of these new excitations relative to that of the optically–allowed $^1B_2 \leftarrow \tilde{X}\ ^1A_1$ transition are given at scattering angles between 15° and 135°. These cross–section ratios peak at large scattering angles—a characteristic of triplet ← singlet excitations. From a comparison of the observed and calculated vertical transition energies, the transitions are assigned as $^3A_1 \leftarrow \tilde{X}$ (5.6–6.2 eV) and $^3B_2 \leftarrow \tilde{X}$ (6.7–7.0 eV). The design and performance of the electron–impact spectrometer used in the above observations is outlined and discussed. (auth)

9611 SEMICLASSICAL S–MATRIX THEORY OF VIBRATIONALLY INELASTIC COLLISIONS BETWEEN TWO DIATOMIC MOLECULES. Cohen, S.C. (Mission Technology Division, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771); Alexander, M.H. J. Chem. Phys. 61: No. 10, 3967-3976 (15 Nov 1974).

We derive a semiclassical S matrix for vibrationally inelastic collisions between two diatomic molecules, assuming a collinear geometry. Our theory incorporates a quantum mechanical superposition principle with classical dynamics and, as such, is an extension of the atom–diatomic molecule theory of Miller. The several approximations to the S matrix differ in the complexity with which the interference between various classical trajectories is treated. We report numerical calculations for H_2–D_2 and D_2–D_2 collisions based on two different interaction potentials. The cruder approximations yield transition probabilities which agree with exact quantum mechanical results to within a factor of 2. More sophisticated approximations to the S matrix yield excellent quantitative agreement with the quantum calculations. We also examine in detail the classical dynamics of the collision process and show that the molecules pass through a number of intermediate states during the encounter. (auth)

9612 VELOCITY DEPENDENCE OF ABSOLUTE TOTAL CROSS SECTIONS FOR LiF SCATTERED BY NONPOLAR TARGETS. Dehmer, P.M.; Wharton, L. (Department of Chemistry and James Franck Institute, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 61: No. 10, 4204-4208 (15 Nov 1974).

Total cross sections accurate to 1–2 percent were measured in the thermal energy range for LiF scattered by rare gas atoms (He, Ne, Xe) and nonpolar molecules (D_2, CH_4). In all cases, the cross sections were pressure independent, indicating that (1) the scattering was not a discernable function of the internal state of the primary beam molecule, and (2) the degree of inelasticity occuring at the outermost impact parameter regions probed was small. This allowed the observed velocity dependence of the cross sections to be interpreted in terms of spherically averaged monotonic potentials except in the cases of

LiF–He, LiF–Ne, and LiF–D_2 where the repulsive and well regions are probed. For every system, the slope dlnQ/dlnv of the cross section deviated from the theoretical slope of −0.4 predicted for a pure van der Waals $1/r^6$ interaction, suggesting the presence of higher-order forces. As the size of the impact parameters explored increased, as increasingly large scattering targets were used, the slopes approached −0.4. For systems which sampled attractive regions of the intermolecular potential, cross sections which were calculated from the Schiff–Landau–Lifschitz (SLL) relation using the induction energy and the Slater–Kirkwood dispersion energy were 6–8 percent smaller than the corresponding experimental cross sections. For LiF–Xe, the system which most closely approached pure van der Waals behavior (with a slope of −0.389), the calculated cross section was 8 percent smaller than experiment. The absence of glory oscillations in the cross sections, attributed to rotational transitions at small impact parameters, provided an estimate of the lower limit for opacity at the glory impact parameter. (auth)

9613 CHARGE TRANSFER BETWEEN O^- IONS AND O_2 MOLECULES IN THE GROUND STATE AND SINGLET DELTA EXCITED STATE. Mathis, R.F.; Snow, W.R. (Physics Department, University of Missouri–Rolla, Rolla, Missouri 65401). J. Chem. Phys. 61: No. 10, 4274-4278 (15 Nov 1974).

A crossed–beam apparatus has been used to study charge transfer between O^- ions and O_2 molecules in the ground state and in the metastable, singlet delta, excited state. The energy of the incident ions ranged from 10 to 10000 eV. The cross section for charge transfer between O^- and ground state O_2 was found to have a maximum of 7.8×10^{-16} cm^2 at about 5 keV. At the lower energies there is good agreement with the previous measurements of Snow et al. and Rutherford and Turner who also used crossed beam techniques. The cross section for charge transfer between O^- and metastable excited O_2 ($^1\Delta_g$) was found to be less than 1×10^{-16} cm^2 over the energy range of 100 to 5000 eV. There are no other experimental measurements for comparison. (auth)

9614 EXCITATION COLLISIONS BETWEEN MAGNESIUM IONS AND INERT GAS ATOMS. Ovchinnikov, V.L.; Shpenik, O.B.; Zapesochnyi, I.P. (Problems Laboratory for the Physics of Electron Collisions, Uzhgorod State University). Sov. Phys.–Tech. Phys. 19: No. 3, 382-384 (Sept 1974).

Excitation processes are studied in collisions of Mg^+ ions with inert gas atoms over the energy range from threshold to 2500 eV and the spectral range 2200–6600 Å. The excitation processes in collisions of Mg^+ with He, Ar, Kr, and Xe atoms are different from those in collisions of Mg^+ with Ne atoms, because of the different natures of the partners. A "competition" between two energetically close inelastic channels of the reaction Mg^+–Ne leads to an oscillation of the total cross sections for excitation of the spectral lines. (auth)

9615 SIMULATION OF ION SCATTERING ON DIATOMIC MOLECULES. Aleksandrov, M.L.; Pliss, N.S.; Shcherbakov, A.P. (Special Construction Bureau for Analytic Instrument Construction, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 19: No. 3, 394-395 (Sept 1974).

A method is proposed for calculating the classical deflection function Θ (b), averaged over all molecular orientations, for the scattering of ions or atoms by diatomic molecules in the kiloelectron–volt range; a modified Firsov potential is used for the interatomic interaction. Analytic expressions approximating Ar^+–N_2 and U^+–N_2 are constructed for the Θ (b) pairs. The calculated functional dependence is recommended for use in statistical simulation of the scattering of ions by diatomic residual gas molecules in mass spectrometers. (auth)

9616 RATIONAL SELECTION OF METHODS FOR MOLECULAR SCATTERING CALCULATIONS. Gordon, R. G. (Harvard Univ., Cambridge, MA). pp 22-29 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

A critical discussion is given of some of the more useful and accurate methods for the calculation of cross sections for various types of molecular collisions. Quantum mechanical, classical and semiclassical methods are considered. Criteria are summarized for the feasibility of various calculations and for the accuracy of the results. A flow chart is formulated, which uses these criteria to select, for given molecules and types of experiments, the easiest calculational method which yields accurate results. Examples of this selection process are given, drawn mainly from recent calculations of inelastic scattering. (auth)

9617 SEMICLASSICAL THEORY FOR COLLISIONS INVOLVING COMPLEXES (COMPOUND STATE RESONANCES) AND FOR BOUND STATE SYSTEMS. Marcus, R. A. (Univ. of Illinois, Urbana). pp 34-44 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

Semiclassical theory for bound states is discussed and a method is described for calculating the eigenvalues for systems not permitting separation of variables. Trajectory data are supplemented by interpolation to connect open ends of quasi-periodic trajectories. The method is also applied to quasi-bound states. Previously, semiclassical S-matrix theory has focused on "direct" reactions. Processes involving complexes (compound state resonances) are treated and an expression is derived for the S-matrix. Use is made of the above analysis of quasi-bound states and of trajectories connecting those states with open channels. The result deduced for the S-matrix has the expected factorization property, and expressions are given for computing the quantities involved. An implication for classical trajectory calculations of complexes is noted. (auth)

9618 MULTIDIMENSIONAL CANONICAL INTEGRALS FOR THE ASYMPTOTIC EVALUATION OF THE S-MATRIX IN SEMICLASSICAL COLLISION THEORY. Connor, J. N. L. (Univ. of Manchester, Eng.). pp 51-58 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

The uniform asymptotic evaluation of multidimensional integrals for the S-matrix in semiclassical collision theory is considered. A concrete example of a nonseparable two-dimensional integral with four coalescing saddle points is chosen since it exhibits many of the features of more general cases. It is shown how a uniform asymptotic approximation can be obtained in terms of a nonseparable two-dimensional canonical integral and its derivatives. This nonseparable two-dimensional canonical integral plays a similar role to the Airy integral in one-dimensional integrals with two coalescing saddle points. The uniform approximation is obtained by applying to the two-dimensional case the asymptotic techniques introduced by Chester et al. for one-dimensional integrals. An exact series representation is obtained for the canonical integral by means of complex variable techniques. The series representation can be used to evaluate the canonical integral for small to moderate values of its arguments, whilst for large values of its arguments existing asymptotic techniques may be used. (auth)

9619 COLLISION COMPLEX DYNAMICS IN ALKALI HALIDE EXCHANGE REACTIONS. Brumer, P.; Karplus, M. (Harvard Univ., Cambridge, MA). pp 80-92 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

Some results of a classical trajectory calculation on NaBr + KCl → NaCl + KBr, a reaction which proceeds via a long-lived collision complex, are presented. The dynamics of the complex are briefly considered and complex lifetimes and the equilibration of vibrational energy are described. The origin of the nonstatistical ratio of reactive to nonreactive product is examined. Its dependence on angular momentum is pointed out and related to evidence for the participation of linear K–Cl–Na–Br. (auth)

9620 ALKALI-METHYL IODIDE REACTIONS. Bunker, D. L.; Goring-Simpson, E. A. (Univ. of California, Irvine). pp 93-99 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

Using empirical Monte Carlo trajectory procedures, a detailed 6-atom potential energy surface was fitted to molecular beam data for Rb + CH_3I → RbI + CH_3. Measurements at a single energy of product recoil velocity and scattering angle distributions, and of the effect of aligning the CH_3I were employed. Then the potential surface was used to predict the energy dependence of the reactive cross section, and to ascertain the consequences of omitting the CH_3 hydrogens from the calculations. Experimental data with which to compare results are expected to appear. (auth)

9621 CENTRAL-FIELD INTERMOLECULAR POTENTIALS FROM THE DIFFERENTIAL ELASTIC SCATTERING OF $HD_2(D_2)$ BY OTHER MOLECULES. Kupperman, A.; Gordon, R. J.; Coggiola, M. J. (California Inst. of Tech., Pasadena). pp 145-157 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

Differential elastic scattering cross sections for the systems $H_2 + O_2$, SF_6, NH_3, CO, and CH_4 and for $D_2 + O_2$, SF_6, and NH_3 were obtained from crossed beam studies. In all cases, rapid quantum oscillations were resolved which permit the determination of intermolecular potential parameters if a central-field assumption is adopted. These potentials were found to be independent of both the isotopic form of the hydrogen molecule, and the relative collision energy. As a result of this, and the ability of these spherical potentials quantitatively to describe the measured scattering, it is concluded that anisotropy effects do not seem to be important in these $H_2(D_2)$ systems. (auth)

9622 SCATTERING OF METASTABLE MERCURY ATOMS. Davidson, T. A.; Fluendy, M. A. D.; Lawley, K. P. (Univ. of Edinburgh). pp 158-166 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

Differential elastic cross sections for the scattering of the metastable 6^3P_2 state of mercury from sodium, potassium, and rubidium were measured at thermal energies. Interference structure is resolved in all cases, suggesting that the atoms interact by a single effective potential in the attractive region probed at these energies. No attenuation of the interference structure is observed so that quenching of the metastable state is not an important process along trajectories sampling only the attractive part of the potential. (auth)

9623 SCATTERING EXPERIMENTS WITH FAST HYDROGEN ATOMS. Velocity Dependence of the Integral Elastic Cross Section with the Rare Gases in the Energy Range 0.01 to 1.00 eV. Bickes, R. W. Jr.; Lantzsch, B.; Toennies, J. P.; Walaschewski, K. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen, Ger.). pp 167-178 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

Integral elastic cross sections of hydrogen atoms scattered by rare gases were measured in the velocity range 1.4 to 14 × 10^5 cm s^{-1} ($0.01 < E_{cm} < 1.00$ eV). The experimental data were fitted to the Lennard-Jones and exp (α, 6) potential models and are found to provide information on the attractive and repulsive parts of the potential. The potential well parameters ϵ, R_m and the Born-Mayer repulsive potential parameters A, α were determined for all of the rare gases. These ϵ, R_m parameters, in combination with the corresponding rare gas dimer parameters, are shown to be consistent with combining rules. (auth)

9624 CHARACTERIZATION OF THE INTERMOLECULAR POTENTIAL WELL FROM ELASTIC MOLECULAR BEAM SCATTERING DATA. Fitts, D. D.; Law, M. L. (Univ. of Pennsylvania, Philadelphia). pp 179-184 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

The spacings of the glory extrema in the velocity dependence of the total elastic cross sections for atom-atom scattering are analyzed in terms of several recently-proposed analytical forms for the argon-argon and neon-neon pair potentials of intermolecular force. In order to subject these new potential forms to more stringent tests, calculations are compared with experimental data on argon-argon scattering. The findings are that a series of potentials developed by Barker and his collaborators to fit macroscopic properties of argon are reasonably consistent with the positions of the glory extrema, and that the so-called MSV potentials proposed by Parson, Siska and Lee to fit their differential scattering cross section measurements on argon are somewhat less consistent. (auth)

9625 MOLECULAR BEAM STUDIES OF INELASTIC COLLISION PROCESSES. Pauly, H. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen, Ger). pp 191-202 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

A brief survey is given on recent molecular beam investigations of inelastic scattering processes. The experimental methods used are discussed and illustrated by some typical experiments. Recent theoretical developments, rotational and variational excitation, and electronic excitation and ionization are covered. (JFP)

9626 MEASUREMENT OF DIFFERENTIAL CROSS SECTIONS FOR INDIVIDUAL ROTATIONAL QUANTUM TRANSITIONS IN THE SCATTERING OF Li^+ BY H_2 AT $E_{c.m.} = 0.6$ eV. van den Bergh, H. E.; Faubel, M.; Toennies, J. P. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen, Ger.). pp 203-210 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

Individual rotational quantum transitions were resolved in the energy loss spectra of Li^+ ions after scattering by H_2 molecules. Time of flight measurements at 0.6 eV center of mass energy yield differential inelastic cross sections for the $j = 0 \rightarrow j = 2$ and $j = 1 \rightarrow j = 3$ rotational transitions relative to the differential elastic cross section ($j = 0 \rightarrow j = 0$; $j = 1 \rightarrow j = 1$) at center of mass angles between 14 and 32°. (auth)

9627 EXPERIMENTAL INELASTIC DIFFERENTIAL CROSS SECTIONS FOR ELECTRONIC EXCITATION IN ATOM–ATOM AND ATOM–MOLECULE COLLISIONS. Gersing, E.; Pauly, H.; Schaedlich, E.; Vonderschen, M. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen, Ger.). pp 211-220 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

Measurements of inelastic differential scattering cross sections for the electronic excitation of alkali metal atoms in collisions with various atoms and molecules are reported. A fast, pulsed alkali atom beam, produced by charge exchange, crosses a thermal energy target beam and is then detected by a surface ionization detector, which is fixed in position at a distance of about 75 cm from the scattering region. The angle of deflection can be changed by moving the alkali beam source around the target. The energy loss of the scattered particles is analyzed by a time-of-flight measurement. Measurements were performed for potassium atoms scattered by rare gas atoms, and for the systems $K-N_2$, $Na-N_2$, K–CO and K–K. The energies range from 100 to 200 eV, the angles from 0 to several degrees (laboratory system). In the alkali-rare gas collisions, the inelastic scattering portion is very small and cross sections have not been determined so far. The same holds for $Na-N_2$. Large inelastic cross sections, however, are found in the case of $K-N_2$, K–CO, and K–K. A preliminary evaluation of the data is discussed. (auth)

9628 EFFECT OF CHANGING REAGENT ENERGY ON REACTION PROBABILITY AND PRODUCT ENERGY-DISTRIBUTION. Ding, A. M. G.; Kirsch, L. J.; Perry, D. S.; Polanyi, J. C.; Schreiber, J. L. (Univ. of Toronto). pp 252-276 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452-.

Experiment and theory were used to ascertain the effect of various forms of reagent energy on the dynamics of three reactions; (a) $F + CHI \rightarrow HF + Cl$, (b) $F + D_2 \rightarrow DF + D$ and (c) $H + Cl_2 \rightarrow HCl + Cl$. The principal experimental technique was the arrested relaxation form of the infrared chemiluminescence method, coupled with a quite wide variation in the temperature of the atomic or the molecular reagent. In addition, a novel approach was employed in which the "fluorescence depletion" of specified vibrational rotational (v,J) states was measured, and hence the relative rate of reaction of these quantum states was obtained. The theoretical technique was the 3D classical trajectory method using LEPS (London, Eyring, Polanyi, Sato) potential-energy hypersurfaces. Some support was obtained from experiment and theory for the following generalizations. ΔT and ΔV enhance the reaction rate-constant, but the former is more effective for these substantially exothermic reactions. (ΔT and ΔV denote reagent translation and vibration enhancements, in excess of the activation-barrier). On the average $\Delta T \rightarrow \Delta T' + \Delta R'$ (the primed energies refer to reaction products; $\Delta R'$ is enhancement in product rotational energy). On the average $\Delta V \rightarrow \Delta V'$. These results are in accord with findings from earlier trajectory studies. The effect of substantial increase in collision-energy can be understood in terms of a contribution from "induced repulsive energy release," and that of increased reagent vibrational energy in terms of both induced repulsive energy release and (more important) "induced attractive energy-release." For the reaction F + HCl the increase in rate constant with reagent vibrational quantum number, k(v), was obtained for v = 0-2, experimentally and theoretically. The fluorescence-depletion method was used for a preliminary measurement of the rotational dependence of reaction rate, k(J), in F + HCl(v = 1). An estimate was obtained for the variation in threshold collision-energy, $E_0^{v'J'}$, with the v′J′ state being formed in the reaction F + HCl(v = 0). (auth)

9629 CROSS-BEAMED REACTIONS OF BARIUM WITH HYDROGEN HALIDES. Measurement of Internal State Distributions By Laser-Induced Fluorescence. Cruse, H. W.; Dagdigian, P. J.; Zare, R. N. (Columbia Univ., New York). pp 277-292 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London England, UK (16 Apr 1973). See CONF-730452-.

The use of laser-induced fluorescence as a molecular beam detector for the measurement of internal state distributions of reaction products is presented and applied to the reactions of barium with the hydorgen halides. It is found that most of the reaction exoergicity appears as translational energy of the products and that the total reactive cross section is positively correlated with the average fraction of the exoergicity appearing as vibrational excitation. (auth)

9630 TRANSLATIONAL ENERGY DEPENDENCE OF PRODUCT ENERGY AND ANGULAR DISTRIBUTION FOR THE K +

CH_3I REACTION. Bernstein, R. B.; Rulis, A. M. (Univ. of Wisconsin, Madison). pp 293-298 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452--.

Molecular beam scattering (velocity-analysis) experiments were carried out for the now classic "rebound" reaction $K + CH_3I \rightarrow KI + CH_3$ over a range of relative translational energies $\bar{E}_T$ from 0.077 to 0.16 eV. Detailed center-of-mass differential reaction cross sections have thereby been obtained (at three energies), showing the expected predominant "backscattering" of the fast-recoiling KI product. There is very little coupling between the angular and recoil energy distributions. The differential solid-angle cross section peaks at 180° (with a half-angle close to 90°) with shape essentially independent of $\bar{E}_T$ over the range of the experiments. The distribution of final translational energy $E_{T'}$ is rather sharp, showing a peak at about 60% of the total available energy. The average recoil energy $\bar{E}_{T'}$ increases with $\bar{E}_T$. These results are combined with previous experimental findings from this laboratory on the CH_3I–K, —Rb reactions (the "alignment effect" and the E_T-dependence of the total reaction cross section), and compared with observations of other groups. A current, overall, experimental summary is presented, to serve as a target for theory. (auth)

9631 SCATTERING OF K ATOMS FROM ORIENTED CF_3I. Reaction At Both Ends. Brooks, P. R. (Rice Univ., Houston, TX). pp 299-306 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452--.

The reaction of K atoms with CF_3I molecules was studied using oriented molecules. If the I end is closest to the incoming K atoms, KI is formed and recoils backwards in the center of mass system. If the CF_3 end is closest to the incoming K atoms, KI is again formed but scatters forwards in the cm. This is in contrast to the oriented CH_3I + Rb reaction in which no forward scattering is observed from configurations with CH_3 closest to the incoming Rb. These observations find possible explanation in two (probably related) mechanisms. Even for CF_3I oriented in what appears to be an unfavorable configuration, it is possible for the K atom to fly past the CF_3 group and strike the I. This is expected to be less likely in CH_3I because the CH_3 shields the I more than does CF_3. For CF_3I (but not CH_3I) charge transfer to a repulsive ionic state is postulated. The products are expected to recoil along the direction of the molecular axis and this roughly accounts for the experimental angular distribution. (auth)

9632 REACTIVE SCATTERING OF ALKALI DIMERS. Alkali Atom-Dimer Exchange Reactions. Whitehead, J. C.; Grice, R. (Cambridge Univ., Eng.). pp 320-330 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452--.

Reactive scattering measurements for the alkali atom-dimer exchange reactions $M' + M_2 \rightarrow MM' + M$ are reported, where $M' = Na, K$ and $M_2 = Cs_2, Rb_2, K_2$. The total reaction cross sections are large $\gtrsim 100$ Å^2, indicating that a major fraction of collisions, captured by the long range van der Waals attraction, lead to reaction. Very little (~10%) of the available energy is disposed into product translation, consequently the MM′ dimer products are highly vibrationally excited (~75%) of the MM′ bond energy). Only an indication of the center-of-mass differential reaction cross sections can be deduced from the data. Calculations of the reaction potential energy surfaces show a broad shallow basin at small internuclear distances, and suggest that the reaction dynamics must be direct or at most involve a short-lived complex. (auth)

9633 FACILE FOUR-CENTER EXCHANGE REACTIONS. King, D. L.; Herschbach, D. R. (Harvard Univ., Cambridge, MA). pp 331-343 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London England, UK (16 Apr 1973). See CONF-730452--.

Molecular beam experiments show that diatomic molecule exchange reactions involving an ionic bond proceed readily at thermal collision energies. Previous work found two such reaction families, alkali halide + alkali halide and dialkali + halogen. This study adds a third, alkali halide + halogen. For $CsI + Cl_2 \rightarrow CsCl + ICl$ the product angular and velocity distributions indicate that a statistical collision complex is formed which persists for many vibrational periods and at least a few rotational periods. This complex presumably corresponds to the alkali trihalide salt, $Ca^+(ClICl)^-$. For the CsBr + ICl reaction only formation of CsCl + IBr was observed, even at collision energies well above the endoergic threshold for formation of CsI + BrCl. The energy disposal is not statistical and the product angular distribution is quite asymmetric about 90°, indicating that a large fraction ($\gtrsim\frac{1}{3}$ to $\frac{1}{2}$) of the collision complexes break up in less than one rotational period. The preferred directions of emission are 0° for CsCl and 180° for IBr, where 0° and 180° designate the incident beam directions (c.m. system) for ICl and CsBr, respectively. These properties can be plausibly interpreted in terms of the electronic structure of the trihalide group. (auth)

9634 REACTIVE SCATTERING OF METHYL RADICALS $CH_3 + ICl, IBr, I_2$. Carter, C. F.; Levy, M. R.; Grice, R. (Cambridge Univ., Eng). pp 357-368 of Molecular Beam Scattering. London; Chemical Society (1973).

From molecular beam scattering conference; London, England, UK (16 Apr 1973). See CONF-730452--.

Angular distribution measurements of methyl iodide reactive scattering from crossed beams of methyl radicals and halogen molecules, ICl, IBr, I_2 are reported. The methyl radical beam is generated by pyrolysis of azomethane flowing through a heated tantalum tube at ~1600 K; the halogen molecule beam issues from a nozzle beam source at ~380 K. Reactively scattered methyl iodide is detected by an electron bombardment mass spectrometer. The differential cross sections peak sideways in center-of-mass coordinates, showing a marked similarity to the corresponding deuterium atom–halogen molecule reactions. Qualitative molecular orbital theory offers a comprehensive rationalization of methyl radical, deuterium atom and halogen atom reaction dynamics with halogen molecules. (auth)

9635 CLASSICAL S-MATRIX OF A LINEAR TRIATOMIC SYSTEM. Ovchinnikova, M. Ya. (Inst. of Chemical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 4, 1276-1286(Oct 1974). (In Russian).

In continuation of investigations on the quasiclassical theory of processes occurring in molecular collisions, a strict integral representation of the classical S-matrix is obtained for a triatomic collinear system (AB + C). Such a representation is required, for example, in an investigation of the threshold behavior of reactive scattering. Underlying its deduction is the application of the asymptotic properties of the quasiclassical Green function and of the exact quantum functions of the initial and final state. (auth)

9636 ELEMENTARY PROCESSES OF VARIATION OF PARTICLE CHARGE STATES IN THE He^{2+}–He INTERACTION. Afrosimov, V. V.; Leiko, G. A.; Mamaev, Yu. A.; Panov, M. N. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 67: No. 4, 1329-1340(Oct 1974). (In Russian).

Direct measurements are carried out on the cross sections for all elementary processes (two-electron charge exchange, one-electron charge exchange, ionization involving removal of two electrons, ionization with removal of one electron and one-electron capture with ionization) occurring in the collision between He^{2+} ions and He atoms for energies between $T_0 \sim 1$ and 100 keV. The measurements are performed with a parallel analysis of charge states of the two colliding particles after the collision and recording of the particles by the coincidence technique. The influence of impurities on the measurement results is circumvented by employing the ^3He isotope. The two-electron charge exchange cross section grows with decrease of energy T_0. The peculiarities of the curve can be ascribed to charge exchange to excited states of the He atom. In the energy region under consideration the one-electron charge exchange cross section is minimal at $T_0 \sim 7$ keV. From a study of particle scattering in one-electron charge exchange and from an analysis of the He_2^{3+} term system it is shown that increase of the cross section at low energies is due to increase of the probability for charge exchange to excited He^+ states with $n = 2$; at higher energies it is due to increase of the probability for charge exchange to the ground state or an excited state with $n \geq 3$. The cross section for ionization with removal of an electron and capture with ionization is found to oscillate in opposite phase on variation of T_0. The oscillations can be ascribed to interference between σ_g and σ_u states of the $He_2^{3+} + e^-$ system. (auth)

9637 COULOMB EXCITATION OF ATOMIC ELECTRONS IN HEAVY ION–ATOM COLLISIONS. Shafroth, S. M. (Univ. of North Carolina, Chapel Hill). J. Franklin Inst.; 298: No. 4 333-340(Oct 1974).

The relation between Coulomb excitation of collective nuclear levels and Coulomb ionization of atomic electrons is discussed. Particular emphasis is placed on K shell ionization. Results of initial experiments with the Triangle Universities Laboratory Cyclo-Graaff where K x-ray production cross sections were measured for Ca, Ti and Ni are given. The energies at which these cross sections reach a maximum value were found and agreed well with theory. The experimental cross sections had the same trend with energy as the theory but were too high by typically 25 percent Reasons for this disagreement are discussed. A similar experiment is described where Ag was the target. In this case theory and experiment agreed quite well. An experiment is described where Bi is bombarded with protons from 2 to 15 MeV and the K x-ray production cross sections are measured. Also Po K x-rays are detected at the higher bombarding energies, and it is shown that Coulomb ionization cannot be responsible. The most likely process for production of these x-rays is internal conversion of excited reaction products following (p,n) and (p,2n) reactions. (auth)

9638 CLASSICAL TRAJECTORY STUDY OF ROTATIONAL EXCITATION IN LOW ENERGY He−CO AND He−H_2 COLLISIONS. Augustin, S. D.; Miller, W. H. (California Univ., Berkeley (USA). Dept. of Chemistry). Chem. Phys. Lett.; 28: No. 2, 149-152(15 Sep 1974).

Classical trajectory calculations for the rotational excitation of CO and H_2 by collision with He have been carried out and compared to the accurate quantum mechanical calculations of other workers. The agreement is reasonably encouraging, although some inherent limitations of this strictly classical approach are observed and discussed. (auth)

9639 THE ESTIMATION OF INTERATOMIC POTENTIALS FOR Li^+−He, He^+−Ne AND He^+−Ar BY THE INVERSION OF ELASTIC DIFFERENTIAL CROSS SECTIONS. Boyle, J. F.; Smith, F. J. (Queen's Univ., Belfast, Northern Ireland (UK)). Physica; 75: No. 2, 351-358(1974).

A modified version of the Lane−Everhart method is used to calculate Li^+−He, He^+−Ne and He^+−Ar interatomic potentials from elastic differential cross sections. Estimates are made of the accuracy of the results and comparisons made with results obtained by other workers. (auth)

9640 INCOHERENT SCATTERING OF GAMMA RAYS BY K-SHELL ELECTRONS. Krishna Reddy, D. V. (Physics Department, Post-Graduate Centre, Warangal, India); Narasimhacharyulu, E.; Murty, D. S. R. (Osmania Univ., Hyderabad (India). Dept. of Physics). Physica; 75: No. 2, 394-405(1974).

The differential cross sections $d\sigma_K$ for the incoherent scattering of 662 keV gamma rays from a 6.0 curie source of cesium-137 by the K-shell electrons of platinum, bismuth, and thorium were studied experimentally using the NaI(Tl) scintillation detectors and fast-slow coincidence method. These cross sections were divided by the Klein−Nishina cross sections $d\sigma_F$ for free and stationary electrons at different scattering angles. The differential cross-section ratios so obtained are compared with the values calculated on the basis of different theories involving some simplifying assumptions and with the previously available experimental values. (auth)

9641 SEMIEMPIRICAL POTENTIALS FOR ALKALI−NOBLE GAS INTERACTIONS. Kielkopf, J.F. (Department of Physics, The Johns Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 61: No. 11, 4733-4739 (1 Dec 1974).

A semiempirical calculation of alkali−noble gas interatomic potentials applicable to excited states of the alkali at internuclear separations and energies important for the interpretation of optical line broadening experiments is presented. The assignment of a single adjustable parameter is based on a comparison with scattering cross−section measurements of ground-state potentials. Evidence that the repulsive interaction scales as the collision cross section of the noble gas atoms for low-energy electrons is presented, and simple formulas are developed to predict potentials for all alkali−noble gas combinations as a function of noble gas dipole and quadrupole polarizabilities and alkali unperturbed energy. Additional comparisons are made with data from satellite bands in Cs−Xe and Cs−Kr spectra, and the impact broadening and shift of alkali spectral lines at low foreign gas pressure is calculated from the predicted potentials and compared with available experimental data. (auth)

9642 APPLICATION OF THE HIGHER ORDER MODIFIED WKB METHOD TO THE LENNARD−JONES POTENTIAL. Wald, S.S.; Lu, P. (Department of Physics, Arizona State University, Tempe, Arizona 85281). J. Chem. Phys. 61: No. 11, 4680-4685 (1 Dec 1974).

We solve the phase shifts of Lennard−Jones potential at low energy by the modified WKB approximation in order to demonstrate the validity of the modified WKB approximation. We choose to solve exactly a model three−turning−point problem. The differences between the potentials of the actual and the model problem are taken care of by WKB type perturbations. We report here the detailed calculations to the order of $\hbar^3$. Although the model potential is somewhat different from the actual potential (except that they have an equal number of turning points), the higher-order terms do contribute to such an extent that the agreement of the phase shifts with the numerical values is satisfactory even near the maximum of the potential where the conventional WKB method is known to fail. (auth)

9643 IONIZING COLLISIONS OF ELECTRONS WITH MOLECULAR HYDROGEN. Shingal, R.; Srivastava, B.B. (Physics Department, Meerut University, Meerut, India); Khare, S.P. J. Chem. Phys. 61: No. 11, 4656-4659 (1 Dec 1974).

The recently proposed semiempirical expression by Jhanwar et al. for ionization cross section per unit energy range has been utilized to calculate the energy spetrum of secondary electrons, total ionization cross sections, stopping power, and mean energy expended per ion pair for the collision of electrons with hydrogen molecules in the energy range of 50 eV−10 keV. Satisfactory agreement with the available experimental data and theoretical results has been obtained. (auth)

9644 INVESTIGATION OF THE PLANAR H+H_2 REACTION NEAR THRESHOLD. Walker, R.B.; Wyatt, R.E. (Department of Chemistry, The University of Texas, Austin, Texas 78712). J. Chem. Phys. 61: No. 11, 4839-4847 (1 Dec 1974).

We report a study of the quantum dynamics of the hydrogen exchange reaction for collisions in which the nuclei move in a single plane throughout the reaction. Our efforts are concentrated at the reaction threshold, for it is here that classical dynamics is least accurate, and yet it is also this region that contributes most heavily to thermal rate constants. Because transition amplitudes in the threshold region are uniformly small, the distorted wave approximation should provide an adequate description of the dynamics. Assuming the ground vibrational state for all molecules, we compute elements of the scattering (S) matrix for several rotational transitions. From the S−matrix elements, we compute reaction probabilities, angular distributions of products (the differential cross section), and the total reaction cross section. The reaction probabilities indicate that reaction is most likely to occur at small impact parameters. The differential cross sections are strongly back peaked, implying that the product molecule recedes in the direction from which the incoming atom approached. Contrary to an earlier study of this reaction, we observe no forward peaking in the differential cross sections. (auth)

9645 COLLISIONAL IONIZATION OF Cs WITH SF_6. Leffert, C.B.; Tang, S.Y.; Rothe, E.W.; Cheng, T.C. (Research Institute for Engineering Sciences and Deparment of Chemical Engineering, Wayne State University, Detroit, Michigan 48202). J. Chem. Phys. 61: No. 11, 4929-4930 (1 Dec 1974).

Recently, Compton and Cooper measured energy thresholds for the production of SF_6^- and SF_5^- from collisions of Cs with SF_6 in a beam−gas experiment. This note describes the use of these reagents to obtain (a) relative cross sections for Cs^+ formation, (b) the electron affinity (EA) of SF_6, and (c) an indication that the SF^-_6 formed is stable. In contrast, when electrons attach to SF_6, the SF^-_6 is metastable. (auth) (AIP)

9646 INTEGRAL CROSS SECTIONS FOR REACTIONS OF H^+ WITH D_2; NEW MEASUREMENTS. Ochs, G.; Teloy, E. (Fakultät für Physik, Universität Freiburg, 78 Freiburg/Br., Germany). J. Chem. Phys. 61: No. 11, 4930-4931 (1 Dec 1974).

Cross sections are reported for the reactions of H^+ with D_2. These measurements offer a test of the trajectory surface hopping calculations performed on diatomics−in−molecules hypersurfaces by Preston, Tully and others. (AIP)

9647 RELATIVISTIC TRANSITION AMPLITUDES IN A CLASS OF O(4, 2) INFINITE MULTIPLETS. II. DISCRETE−CONTINUUM TRANSITIONS. Barut, A.O.; Rasmussen, W.; Salamo, S. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 10: No. 2, 630-635 (15 July 1974).

A general relativistic formula is derived in closed form for the photoeffect amplitude from a composite system of spin μ described by O(4, 2) infinite−multiplet wave functions. For $\mu = 0$, it reduces to the relativistic H−atom photoeffect amplitude. (auth)

9648 COMPARISON OF QUASICLASSICAL TRAJECTORY AND CLASSICAL S−MATRIX TREATMENTS OF COLLINEAR COLLISIONS OF F AND D_2. Whitlock, P.A.; Muckerman, J.T. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). J. Chem. Phys. 61: No. 11, 4618-4629 (1 Dec 1974).

The dynamics of collinear collisions of F with $D_2(n^a{}_1=0)$ have been studied using standard quasiclassical trajectory and classical S−matrix (semiclassical) techniques for collision energies ranging from 0.65 to 5.50 kcal $mole^{-1}$ in the center−of−mass system. The results are compared to previous quantum mechanical calculations on the same potential energy surface. At most only three transitions (NR $0\rightarrow0$, R $0\rightarrow3$, and R $0\rightarrow4$) are "classically allowed" at any energy studied. Of these, the only transition for which the "uniform semiclassical" and quasiclassical results are significantly different is R $0\rightarrow4$. The predicted energy dependence of this transition is discussed in terms of recent experimental determinations of the relative rates of R $0\rightarrow4$ and R $0\rightarrow3$. The "classically forbidden" R $0\rightarrow2$ transition is predicted (using the complex−valued trajectory method) to have a probability which exhibits distinct oscillations as a function of collision energy. (auth)

9649 MERGING BEAMS STUDY OF THE $H_2^+(H_2,H)H_3^+$, $H_2^+(D_2,H)HD_2^+$, AND $D_2^+(H_2,H)HD_2^+$ REACTION MECHANISMS.

Lees, A.B.; Rol, P.K. (Research Institute for Engineering Sciences and The Department of Chemical Engineering and Material Sciences, Wayne State University, Detroit, Michigan 48202). J. Chem. Phys. 61: No. 11, 4444-4449 (1 Dec 1974).

A merging beams apparatus was used to measure energy distributions of ions formed in the $H_2^+(H_2,H)H_3^+$ reaction for collisions with relative energy W in the range $0.1\ eV \leqslant W \leqslant 10.0\ eV$. The major components of the reaction, proton and hydrogen atom transfer, were resolved through study of the $H_2^+(D_2,H)HD_2^+$ and $D_2^+(H_2,H)HD_2^+$ reactions, respectively. Each component follows predominantly direct interactions at all energies studied and contributes nearly equally to the $H_2^+(H_2,H)H_3^+$ reaction for $W \leqslant 6$ eV. At higher energies, hydrogen atom transfer becomes increasingly more important; the final relative energy W· agrees qualitatively with the abandoned atom model. The growth of a satellite peak for $W > 7$ eV indicates the appearance of an electronically excited product. (auth)

9650 SEMICLASSICAL COLLISION THEORY. MULTIDIMENSIONAL BESSEL UNIFORM APPROXIMATION. Kreek, H.; Ellis, R.L.; Marcus, R.A. (Department of Chemistry, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 61: No. 11, 4540-4544 (1 Dec 1974).

A multidimensional Bessel uniform approximation for the semiclassical S matrix is derived for the case of four real stationary phase points. A formula is also developed for the particular case when four stationary phase points may be considered to be well separated in pairs. The latter equation is then used in the treatment of two real and two complex stationary phase points. (auth)

9651 ELECTRON SCATTERING FROM NO AND N_2O BELOW 10 eV. Zecca, A.; Lazzizzera, I. (University of Bari, Bari, Italy); Krauss, M.; Kuyatt, C.E. J. Chem. Phys. 61: No. 11, 4560-4566 (1 Dec 1974).

Total electron scattering cross sections for NO and N_2O in the energy range 0—10 eV were obtained from exponential attenuation in a straight—line collision chamber without a confining magnetic field. Good agreement is obtained with previous measurements where available. For NO, cross sections have been obtained for the first time for resonance structure in the energy range 0—2.5 eV. There appear to be small, sharp resonances between the large resonances. For both NO and N_2O the cross section is observed to increase rapidly at very low energies. Structure in the cross sections is interpreted in terms of electronic states of NO^- and N_2O^-. (auth)

9652 STANDING—WAVE MODIFICATION OF REGGE TRAJECTORIES AND ITS APPLICATION TO ATOM—ATOM AND ION—ATOM SCATTERING AT THERMAL ENERGIES. Tani, S. (Physics Department, Marquette University, Milwaukee, Wisconsin 53233); Inokuti, M. J. Chem. Phys. 61: No. 11, 4422-4432 (1 Dec 1974).

We consider the global behavior of the phase shift δ (k, l) as a function of linear momentum k and angular momentum l. The loci of points at which $\delta (k, l) = \pi/2 \pmod{\pi}$ represent essential features of an interaction potential. In a series of examples, we illustrate close relations of these loci to (1) the strength of the interaction potential, (2) the presence of glory undulation in the total cross section, (3) the orbiting effect due to penetration through the centrifugal barrier at low energies, and (4) the domain in which semiclassical approximations are valid. On certain theoretical grounds, one may consider this new method to be a standing—wave modification of the direct—channel Regge trajectory approach. An application to the $He-Li^+$ scattering is also presented. (auth)

9653 QUANTUM CALCULATIONS OF PLANAR REACTIVE $H + H_2$. III. "LABELED NUCLEI" AND ANGULAR DISTRIBUTIONS. Altenberger—Siczek, A.; Light, J.C. (Department of Chemistry and The James Franck Institute, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 61: No. 11, 4373-4379 (1 Dec 1974).

The quantum calculation of reactive scattering of $H + H_2$ in a plane has been modified by the utilization of a new method for projection of the initial rotational manifold onto the final one at the matching surface. This bifurcation method corresponds to the "labeled nuclei" calculation and yields predominant backward scattering for the angular distributions of products in accord with those expected on both theoretical and experimental grounds. Results are presented and comparisons with previous work are made. (auth)

9654 AB-INITIO OPTICAL MODEL THEORY OF ELASTIC ELECTRON-ATOM SCATTERING. Byron, F. W. Jr. (Massachusetts Univ., Amherst (USA)); Joachain, C. J. (Brussels Univ. (Belgium). Faculte des Sciences). Phys. Lett., A; 49: No. 4, 306-308(23 Sep 1974).

The elastic scattering of fast electrons by atoms is analyzed using a second order optical potential obtained from first principles. The results are in excellent agreement with recent absolute experimental data for electron-helium and electron-neon collisions. (auth)

9655 ON THE ISOTOPE DEPENDENCE OF THE CLOSE COUPLING CALCULATIONS FOR THREE BODY ATOMIC COLLISIONS. Khayrallah, G. A. (Yale Univ., New Haven, Conn. (USA). Dept. of Physics). Phys. Lett., A; 49: No. 4, 341-342(23 Sep 1974).

It has been assumed tacitly by experimentalists and theorists that cross sections calculated or measured, in collisions of different isotopes of a projectile with a target can be compared at the same incident projectile velocity, and that for the same incident relative velocity the cross sections for excitation and charge-transfer do not depend significantly on the mass of the projectile. No proof of this assumption was put forward. It is claimed that this assumption is not valid in the close coupling calculations with a straight line trajectory. (auth)

9656 IONIZATION AND DISSOCIATION OF CO AND H_2 BY 6.7 TO 85 keV $^3He^{2+}$ IONS. Graham, W. G.; Latimer, C. J.; Browning, R.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 14, L405-L408(1 Oct 1974).

The ionization and dissociation of CO and H_2 by fast $^3He^{2+}$ ions were studied experimentally. Cross sections for secondary ion formation were measured and interpreted in terms of predissociative and Auger processes. (auth)

9657 GAS TARGET EXPERIMENTS OF K-SHELL VACANCY SHARING IN ASYMMETRIC ION—ATOM COLLISIONS. Stolterfoht, N.; Ziem, P.; Ridder, D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). J. Phys., B (London); 7: No. 14, L409-L413 (1 Oct 1974).

K-shell vacancy sharing was measured using 200 to 500 keV Ne incident on Na, Ne, O_2 and N_2 gas targets. The experimental results are in good agreement with a previous theory assuming radial coupling between the $2p\sigma - 1s\sigma$ molecular orbitals. (auth)

9658 ELECTRON SPIN POLARIZATION BY SCATTERING ON ORIENTED ATOMS WITH SPIN S = 1. Drukarev, G. F.; Ob'edkov, V. D. Vestn. Leningrad. Univ., Fiz., Khim.; No. 2, 20-23(May 1974). (In Russian).

Spin polarization effects in electron-atom scattering, caused by the exchange interaction, are considered. The spin s of the target is supposed to be equal to one (s = 1). The formalism used is based on spin density matrix techniques. The 6 × 6 transition matrix is expressed in terms of conveniently chosen amplitudes of scattering. The polarization characteristics of the electron and the target after scattering were obtained in the analytical form. (auth)

9659 NOTE ON THE OFF-SHELL COULOMB T-MATRIX. IV. The Effect of Long Range Distortion. Roberts, M. J. (Univ. of Stirling, Eng.). J. Phys., B (London); 7: No. 14, L397-L400 (1 Oct 1974).

The long-range nature of the Coulomb potential is taken into account in the derivation of a distorted T-matrix. When applied to elastic electron—hydrogen collisions the results are considerably better than those presented in a previous letter (Hulton and Roberts. J. Phys. B. Atom. Molec. Phys.; 5: 104-6 (1972)) and compare favorably with the eikonal approximation to the second order Faddeev-Watson expansion. (auth)

9660 ELECTRON—HYDROGEN ATOM SCATTERING IN THE PRESENCE OF AN ELECTROMAGNETIC FIELD. Bhakar, B. S.; Choudhury, B. J. (Univ. of Manitoba, Winnipeg). J. Phys., B (London); 7: No. 14, 1866-1874(1 Oct 1974).

The scattering of an electron with a hydrogen atom in the presence of an electromagnetic field was considered. A differential cross section formula was obtained for the process in which the atom gets excited by the combined action of the electron and the electromagnetic field. Two limiting cases of the scattering amplitude were studied explicitly: the Born approximation limit and the low frequency limit. As a by-product of this calculation a differential cross section formula for the inverse bremsstrahlung process was obtained which contains the form factor of the atom. (auth)

9661 QUANTUM MECHANICAL SECOND VIRIAL COEFFICIENT FOR ANISOTROPIC INTERACTIONS: HYDROGEN MOLECULE-HELIUM ATOM. Larsen, S. Y. (Instituto Mexicano Del Petroleo, Mexico City); Poll, J. D. Can. J. Phys.; 52: No. 19, 1914-1925(1 Oct 1974).

A derivation of a generalized Uhlenbeck and Beth formula is given which relies neither on the notion of a box nor on formal scattering theory. The expression for the 2nd virial coefficient then involves bound state energies as well as eigenphase shifts associated with the asymptotic description of a coupled (open and closed) channel calculation. The proof and specific details of such a calculation are worked out for the case of a hydrogen molecule interacting with a helium atom. (auth)

9662 ELECTRON LOSS AND DE-EXCITATION OF 5-500 keV METASTABLE HYDROGEN ATOMS IN PASSAGE THROUGH GAS TARGETS. Gilbody, H. B.; Corr, J. L. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 14, 1953-1967(1 Oct 1974).

The collisional destruction of 5 to 500 keV 2s metastable hydrogen atoms in passage through H_2, He, Ar, Kr and N_2 was investigated using a modulated beam technique. Cross sections $\sigma_{2s.1}$ for one-electron loss and total cross sections σ_D for all collisional destruction processes were separately determined. Electron capture leading to negative ion formation is found to be relatively unlikely while at the highest energies considered $\sigma_{2s.1} \simeq \sigma_D$. Cross sections for de-excitation $\sigma_{2s.1s} \simeq (\sigma_D - \sigma_{2s.1})$ increase in relative importance with decreasing impact energy. Above about 100 keV, measured loss cross sections are in good accord with values predicted by the Bates-Walker classical impulse approximation, while the present values of both $\sigma_{2s.1s}$ and σ_D for H_2 and He agree with estimates based on the first Born approximation. The growth and equilibration of H(2s) atoms in electron capture by protons in H_2, He, Ar and N_2 was also investigated and interpreted quantitatively in terms of the relevant collision mechanisms. (auth)

9663 IONIZATION OF EXCITED HYDROGEN AND GROUND STATE NEON BY ELECTRON IMPACT. Knapp, E. W.; Schulz, M. (Trier-Kaiserslautern Univ., Ger.). J. Phys., B (London); 7: No. 14, 1875-1890(1 Oct 1974).

The five-fold differential cross section $\sigma^{(5)}_{nlm}$ for ionization of the state $|nlm>$ is calculated for hydrogen and neon in two versions of the Born approximation. It is shown for the hydrogen $\sigma^{(5)}_{nlm}$ that the number of minima of the angular correlation in the forward direction increases with the principal quantum number. The cross sections $\sigma^{(5)}_{nl} = \Sigma_m \sigma^{(5)}_{nlm}$ have at the direction of the momentum transfer a maximum for $l = 0$ and a distinct minimum for $l = 1$, besides extreme values at other angles. For neon differential cross sections of lower order and the total cross section $\sigma^{(0)}$ were calculated by integrating over the solid angles of both electrons and over their energy distribution. It is found that $\sigma^{(0)}$ lies below the experimental results probably because no resonance or autoionization effects are included. It is shown for neon that the cross section $\sigma^{(5)}_{nl}$ lacks elementary invariance properties if the wave function $|\phi_b>$ of the ejected electron is made orthogonal by the normal Schmidt procedure only to a particular substate (one m-value) of one bound orbital. This shortcoming can be cured either by orthogonalizing to all m-states of a given l or by taking into account the exchange of the slow electron with all bound ones. This method reduces the 2s cross section of neon by a factor of 4, as compared with the Schmidt orthogonalization. (auth)

9664 COMPUTER PROGRAMS FOR THE CALCULATION OF ELECTRON-ATOM COLLISION CROSS SECTIONS. II. A Numerical Method for Solving the Coupled Integro-Differential Equations. Seaton, M. J. (University Coll., London). J. Phys., B (London); 7: No. 14, 1817-1840(1 Oct 1974).

The coupled integro-differential equations, described in Paper 1 (Eissner and Seaton. J. Phys. B. Atom. Molec. Phys.; 5: 2187-98 (1972)), are reduced to linear algebraic equations. The finite difference formulas used are described in detail. The linear algebraic equations are solved using a technique which has good numerical stability and which gives good linear independence in the solution vectors. The method is economic in the use of computer time and storage. The computer program, IMPACT (Seaton and Wilson. J. Phys. B. Atom. Molec. Phys.; 5: L1-3 (1972)) has been tested extensively and has been used for a number of new calculations. (auth)

9665 STUDIES OF THE THRESHOLD ELECTRON IMPACT IONIZATION OF HELIUM. Cvejanovic, S.; Read, F. H. (Univ. of Manchester, Eng.). J. Phys., B (London); 7: No. 14, 1841-1852 (1 Oct 1974).

Studies were made of the two outgoing electrons in ionization events for which the energy difference E between the total energy and the ionization energy is in the range from 0.2 to 3.0 eV. A coincidence time-of-flight technique was used to measure their energy distribution and angular correlation functions, and a noncoincidence technique was used to measure the partial cross section for the production of very slow electrons. The energy distribution function was found to be uniform in the range of E from 0.2 to 0.8 eV and the width of the angular correlation function was found to increase with the energy E in a way which is consistent with a $E^{1/4}$ dependence. The yield of very low energy electrons is consistent, in the range of E from 0.2 to 1.7 eV, with a total ionization cross section having the energy dependence E^n, where $n = 1.131 \pm 0.019$. These results are all consistent with the Wannier (Phys. Rev.; 90: 817-825 (1953))-Peterkop (J. Phys. B. Atom. Molec. Phys.; 4: 513-21 (1971))-Rau (Phys. Rev.; A4: 207-20 (1971)) theory. (auth)

9666 LASER INDUCED PHOTODISSOCIATION OF H_2^+ AND D_2^+ IONS. van Asselt, N.P.F.B.; Maas, J. G.; Los, J. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Chem. Phys. (Amsterdam); 5: No. 3, 429-438(Sep 1974).

Photodissociation of H_2^+ and D_2^+ has been observed in a crossed beam experiment. A laser is used as photon source. The ion and laser beam cross each other inside the laser cavity. The momentum spectra of the resulting H^+ or D^+ fragments are recorded with a mass spectrometer. From the spectra the excess kinetic energy is calculated. These values agree with the theoretically expected ones within the experimental error. From the measured intensity distribution the relative population for several vibrational states in the primary ion beam is calculated. The values deviate from the usual assumed Franck-Condon pattern as well as from the values reported by Dunn. The angular dependence of the fragments is also measured. This dependence indicates a polarization of the primary beam perpendicular to its direction. (auth)

Atomic Theory

9667 SOME NEW ENERGY FORMULAS FOR ATOMS AND MOLECULES. Politzer, P.; Parr, R.G. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 61: No. 10, 4258-4262 (15 Nov 1974).

An exact formula for the nonrelativistic ground—state energy of an atom or molecule is derived: The function ϕ_A is defined for each nucleus A by $\phi_A = r_A V/Z_A$, where Z_A is the nuclear charge and V is the total electrostatic potential produced by the electrons and nuclei at a point r_A measured from nucleus A. ϕ_A represents the screening of nucleus A by the electrons and other nuclei. The integration must be carried out over an isoelectronic path, the number of electrons being equal to the actual number N in the atom or molecule being considered. Equation (I) gives the molecular energy as a sum of atomiclike terms. It is shown that atomic energies can be calculated with remarkable accuracy with the equation using Hartree—Fock values for $(\partial\phi/\partial r)_{r=0}$. Equation (II) is identical in form with a relationship in the Thomas—Fermi theory of atoms. These equations emphasize the dependence of atomic and molecular energies upon the electrostatic potentials at the nuclei. This is further discussed and illustrated. A semiempirical formula for the energy of an atom as a power series in $Z^{1/3}$ is also presented. (auth)

9668 EXCHANGE ENERGY IN THE THOMAS—FERMI MODEL. Handler, G.S. (Department of Chemistry, University of Georgia, Athens, Georgia 30602). J. Chem. Phys. 61: No. 11, 4824-4829 (1 Dec 1974).

The concept of exchange energy as it arises in Thomas—Fermi theory is examined. It is found that the imposition of Hermitian symmetry upon the single-particle Thomas—Fermi density matrix changes the single-particle exchange energy density operator in a drastic way. (auth)

9669 EXCITATION OF ATOMS TO STATES OF HIGH ORBITAL MOMENTUM. Fano, U. (Univ. of Chicago). J. Phys., B (London); 7: No. 14, L401-L404(1 Oct 1974).

High-l states of atoms, though statistically predominant, have not been studied much in the laboratory. They should, however, be excited in electron—atom collisions at energies within a fraction of 1 eV above or below the ionization threshold. This qualitative prediction derives from the Wannier theory and is, in fact, implied by Cvejanović and Read's recent angular distribution experiment (J. Phys. B. Atom. Molec. Phys.; 7: 1841-52 (1974)). Application of the same theory below threshold provides a qualitative interpretation of a related experiment. (auth)

9670 EFFECT OF QUANTUM INHOMOGENEITY CORRECTIONS IN SEMI-STATISTICAL THOMAS—FERMI CALCULATIONS FOR ATOMS. Stauffer, J. A.; Darewych, J. W. (York Univ., Downsview, Ont.). Can. J. Phys.; 52: No. 19, 1926-1932(1 Oct 1974).

Approximate solutions to the Thomas—Fermi equation with so-called "quantum correction terms" were obtained by the use of a variational method. The results for krypton support the conclusions of Tomishima and Yonei that the coefficient of the gradient term should be $^1/_5$ of the value derived by Kirzhnits. On the other hand, when the use of these equations is restricted to a region of the atom where the gradient expansion of Kirzhnits might be expected to be valid, the Kirzhnits value of the constant gives the better results, but the best results are obtained with no correction term at all (i.e. with the Thomas—Fermi—Dirac equation). (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

9671 VISCOUS MAGNETOFLUIDDYNAMIC FLOW IN AN ANNULUS: A FIRST ORDER MAGNETIC PRANDTL NUMBER EXPANSION. Matalon, M.; Schweitzer, S. (Tel Aviv Univ., Israel). Israel J. Technol.; 11: No. 6, 395-402(1973).

The problem of a liquid conductor confined between two concentric cylinder electrodes and driven electromagnetically is considered. The steady, three-dimensional viscous case is treated asymptotically in the limit of small magnetic Prandtl numbers. Results for the first order solution are discussed explicitly. (auth)

9672 INSTABILITIES IN THE FLOW OF CONDUCTING LIQUIDS. II. Aref'ev, V. I. Magn. Gidrodin.; No. 3, 45-51 (1974). (In Russian).

In a series of experiments on the study of the flow of conducting fluids in MHD channels a low threshold for the appearance of instabilities at Reynold's numbers, contrary to the theoretical predictions based on the one-fluid approximation, was observed. Attention was given to the special role of the kinetic effects related with the thermal motion of ions in the development of the instabilities. The question was studied in the framework of two-fluid hydrodynamics. Dispersion equations for the oscillation with low threshold of excitation were obtained and studied on stabilities. (tr-auth)

9673 NONLINEAR STABILITY OF PERFECTLY CONDUCTING FLOWS. Rudraiah, N.; Chandrasekhara, B. C.; Shanthakumar, M. (Bangalore Univ., India). Indian J. Pure Appl. Math.; 3: No. 6, 1064-1072(Nov 1972).

The non-linear stability of a convective flow of a non-viscous perfectly conducting fluid is investigated using the energy method. A universal stability estimate, namely a stability limit for motions subject to arbitrary non-linear disturbances, is obtained in terms of the Alfvén number (S), the Rayleigh number (R_a), the Prandtl number (P_r) and the number ϵ connected with the geometry of the flow. The existence of an open region of certain stability region near the origin of the (R_a, S) Cartesian plane for a fixed ϵ/P_r is also shown. Further, the universal stability limit is improved using the variational techniques, by obtaining the appropriate Euler–Lagrange equations. A uniqueness theorem for steady flow is also established. It is found that the magnetic field decreases the stability region as opposed to the linear theory where the introduction of the magnetic field inhibited instability. (auth)

9674 UNSTEADY MAGNETOHYDRODYNAMIC FLOW IN A RECTANGULAR CHANNEL UNDER TRANSVERSE MAGNETIC FIELD. Gupta, S. C.; Singh, B. (Univ. of Roorkee, India). Indian J. Pure Appl. Math.; 3: No. 6, 1038-1047(Nov 1972).

An exact solution for unsteady magnetohydrodynamic flow in a rectangular pipe of non-conducting walls in the presence of a transverse uniform magnetic field has been obtained for the case when Reynolds' and magnetic Reynolds' numbers are equal. Graphs and tables are given showing the behavior of the induced magnetic field and the velocity of flow at different times for different values of the Hartmann number. The results for a pipe of square cross-section, the Shercliff's solution for steady flow, and the corresponding unsteady hydrodynamic flow have been deduced as special cases. (auth)

9675 POSSIBILITY OF MAGNETIC FIELDS AND FLUID FLOWS PARALLEL TO THE X-LINE IN A RE-CONNEXION GEOMETRY. Cowley, S. W. H. (Imperial Coll. of Science and Tech., London). J. Plasma Phys.; 12: No. 2, 319-339(Oct 1974).

The possibility of modifying the Sonnerup solution for incompressible fluid flow about an X-type re-connection line, to include fields and flows parallel to the X line is considered. It is found that such fields and flows may change across the discontinuities of the Sonnerup solution. By considering the requirements imposed by a proper matching across the various regions of flow, and by the integral conservation properties of the diffusion region, the restrictions that are imposed on this parallel field and flow, and on the arrangement of the discontinuity planes around the diffusion region are sought. It is found that four types of such arrangements are possible, each corresponding to a different set of restrictions on the parallel field and flow. In one case, where all the discontinuity planes intersect at a common line, the "parallel" parameters of the in-flow and out-flow regions may be arbitrarily and independently chosen. Of the remaining three cases, one contains solutions with uniform parallel fields and flows, while the other two depend for their existence on large fluid flow or magnetic field shears across the two in-flow regions. (auth)

9676 SOLVABILITY OF ONE NONLINEAR NONSTATIONARY BOUNDARY-VALUE PROBLEM OF THE MAGNETIC HYDRODYNAMICS IN SPACES $W^{2,1}_{px,t}(Q_T)$, $p > 1$, AND $C^{2+\alpha,1+\alpha/2}_{x,t}(Q_T)$. Sakhaev, Sh. (Inst. of Mathematics and Mechanics, Alma-Ata, USSR). Dokl. Akad. Nauk SSSR; 213: No. 4, 815-818(1 Dec 1973). (In Russian).

The solubility of one nonlinear nonstationary boundary-value problems in magnetohydrodynamics is shown. The precise evaluation of the solution is established. The differential properties of the solution in every cylinder Q_T up to its boundary are studied. (JSR)

9677 MOTION OF A SPHERICAL NON-CONDUCTING PARTICLE IN A ROTATING MHD FLOW. Kapusta, A. B.; Ved'kalov, I. R. Magn. Gidrodin.; No. 3, 57-61(1974). (In Russian).

The parameters of the relative motion of a spherical nonconducting particle in an electrically conducting fluid moving under the influence of a rotating magnetic field in a cylindrical vessel were studied. It was established that there are two types of trajectories of the particle motion depending on the value of the coefficient of resistance of the medium, whose value is determined by the flow structure (laminar or turbulent). With small values of the coefficient of resistance the trajectory of motion of the particle is close to cycloid and with large values the trajectory is of the logarithmic spiral type. (tr-auth)

9678 SECONDARY FLOWS OF A LIQUID BETWEEN ROTATING COAXIAL CYLINDERS OF FINITE LENGTH IN THE AXIAL MAGNETIC FIELD. Gorbachev, L. P.; Tubin, A. A. Magn. Gidrodin.; No. 3, 37-40(1974). (In Russian).

The appearance in the axial magnetic field of secondary flows of a viscous incompressible electrically conducting liquid filling the gaps between rotating coaxial cylinders of finite length was studied. Under the assumption of the smallness of the intensity of the secondary flows, a solution was obtained for a linearized system of MHD equations. (tr-auth)

9679 FLOW STRUCTURE IN A CONSTANT MAGNETIC FIELD CHANGING PERIODICALLY IN THE DIRECTION OF FLOW. Gel'fgat, Yu. M.; Ol'shanskii, S. V. Magn. Gidrodin.; No. 3, 31-36(1974). (In Russian).

The results of the experimental study of the effect of a constant magnetic field periodically changing in the direction of flow on the flow structure were reported. It was shown that in such a field intense M-shaped velocity profiles are formed at Stewart numbers $N > 1$. The dependence of the change of the velocity profile on the spacing of the field and its intensity was determined. The role of the accumulation of the profile deformation effect during passage by the flow of the series of subsequent field amplitudes was confirmed. (tr-auth)

9680 MAGNETOHYDRODYNAMIC FLOW PAST A FINE PROFILE IN AN INCLINED MAGNETIC FIELD. Sher'yazdanov, G. B. Magn. Gidrodin.; No. 3, 27-30(1974). (In Russian).

The flow past a fine profile of any geometry of a viscous incompressible conducting fluid was examined. Invariant functions were represented by a stepped series of small parameters of the profile geometry and in the first approximation of the problem were reduced to the search for one invariant harmonic function. By means of the function of the complex variable the boundary problem for a harmonic function on the section along the abscissa was transformed into a boundary problem at a single circle. The determination of the function of complex potential made it possible to find the distribution of the MHD values in all flow fields and the aerodynamic characteristics. (tr-auth)

9681 STABILITY OF THE LAMINAR FLOW OF A CONDUCTING FLUID IN A TRANSVERSE MAGNETIC FIELD. Sagalakov, A. M. Magn. Gidrodin.; No. 3, 8-16(1974). (In Russian).

The resistance to small perturbations of the Hartmann flow in channels with good conducting walls was studied at small values of the total flow. For a given flow the presence of a longitudinal magnetic field very close to the channel walls is characteristic. In the region of small Prandtl magnetic numbers δ a substantial increase of the critical Reynold's number Re_* was detected, even at relatively small Reynold's magnetic number R_m, if the Hartmann number Ha remains large. A substantial role of three-dimensional perturbations, appearing in the general case, is played by supplementary zones of instability on the plane of Re_* and R_m in which the two-dimensional perturbations are attenuated. At large R_m the dependence of Re_* on R_m becomes linear except at small Ha. In the region of large δ the instability is developed at small Ha. As long as Ha < 0.295 the instability can occur at any small Re. The minimum critical Reynolds magnetic number (for Re → 0) is reached at Ha = 0.195 and equals 1.34 × 10^3. If Ha remains large (Ha ≳ 0.5) the instability of the flow with respect to antisymmetric (according to rate) perturbations lead to the formation of a region of instability on the Re and R_m plane limited by loop-shaped curves. With the increase of Ha this loop rapidly is displaced in the direction of all large values of Re and R_m. The resulting region of flow stability on the Re and R_m plane can be finite probably only at small Ha. The case Ha = 0.1 was used as an example. (tr-auth)

9682 ON THE EXISTENCE AND UNIQUENESS OF MAGNETOHYDRODYNAMICAL SHOCK WAVE STRUCTURES, DISREGARDING THERMAL CONDUCTIVITY. Skiepko, J. (Univ., Warsaw). Arch. Mech. Stosow.; 26: No. 2, 263-269(1974).

In an earlier paper (in print) the author proved the existence of a slow and fast shock wave structure for a perfect gas with shear velocity disregarded. The proof was based on the topological properties of the generalized thermodynamical potential. Using the same method, the existence of slow and fast shock wave structures is proved but under the assumption that the coefficient of thermal conductivity is equal to zero, and the other three coefficients of dissipation are positive functions of class C(1) of the physical parameters. The uniqueness of the fast shock wave structure and the nonuniqueness of the slow shock wave structure are demonstrated. The latter result is also true under the author's assumptions where the coefficients of shear velocity is put equal to zero instead of that of thermal conductivity. (IAA)

9683 FLUID MECHANICS. Hydromechanics. Abdulalefmkhan, M. (Lucknow Univ., India). Ganita; 23: No. 1, 31-36(1972).

The motion of viscous, electrically conducting incompressible fluid over a semi-infinite solid wall with a transverse magnetic field has been analyzed. The solid wall with a transverse magnetic field has been analyzed. The solid wall of given conductivity is moving with uniform velocity parallel to its plane face till it is suddenly stopped at time t = 0. (Indian Sci. Abstr.)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 9737 and 9738.

9684 (KEK-73-10) PROCEEDINGS OF THE 1973 KEK SUMMER SCHOOL HELD AT NATIONAL LABORATORY FOR HIGH ENERGY PHYSICS (KEK) ON JULY 17–21, 1973. Kawaguchi, M.; Takahashi, K. (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Dec 1973. 294p. (CONF-730746-).

From proceedings for high energy physics; Ibaraki, Japan (17 Jul 1973).

Separate abstracts were prepared for the 9 papers presented. (WHK)

9685 FUNDAMENTAL PHYSICS AND INSTRUMENTAL TECHNOLOGY. Schumacher, D. L. Found. Phys.; 4: No. 4, 481-497(Dec 1974).

The working situation prevailing in theoretical and experimental physics today is held to be inseparable from the interpretation of quantum theory and constitutes an embodiment of its implicit difficulties. Such an understanding of the present situation in fundamental physics provides a quite different basis for ideas than the formulation of alternative courses of action (experiments) or alternative forms of knowledge (theories), which proceeds from the belief in a full separation of theory from experiment in this field. It is argued that this underlying belief is not well founded. One must therefore consider the technical details of the field together with its foundations, and thus especially the situation produced by fundamental physics, including, in particular, the growth of high energy technology, which exerts a determining influence on the further course of the subject. (auth)

Electromagnetic

Refer also to abstract 9310.

9686 (DESY-74/45) PRODUCTION OF HYPERONS BY VIRTUAL PHOTONS. Azemoon, T.; Dammann, I.; Driver, C.; Lueke, D.; Specht, G.; Heinloth, K.; Ackermann, H.; Ganssauge, E.; Janata, F.; Schmidt, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Sep 1974. 41p. Dep. NTIS (US Sales Only) $5.25.

The electroproduction of K^+Y on protons, $e\ p \rightarrow e\ K^+\ Y$ ($Y = \Lambda$; Σ^0; $\Sigma'^0(1385)$, $\Lambda'(1405)$; $\Lambda'(1520)$) was investigated by measuring the scattered electron and the produced K^+-meson in coincidence. The differential cross sections were determined as functions of W, q^2, t, and $\phi_{K\gamma}$ in the kinematical region: $1.9 \leq W \leq 2.8$ GeV, $-0.10 \geq q^2 \geq -0.60$ GeV^2/c^2, $t_{min} \geq t \geq t_{min} - 0.33$ GeV^2/c^2, $0 \leq \phi_{K\gamma} \leq 360°$. (auth)

9687 NEW EXPERIMENTAL DATA ON THE PROTON ELECTROMAGNETIC POLARIZABILITIES. Baranov, P.; Buinov, G.; Godin, V.; Kuznetzova, V.; Petrunkin, V.; Tatarinskaya, L.; Shirthenko, V.; Shtarkov, L.; Yurtchenko, V.; Yanulis, Yu. (AN SSSR, Moscow. Fizicheskij Inst.). Phys. Lett., B; 52: No. 1, 122-124 (16 Sep 1974).

The γp-elastic scattering cross section was measured in the photon energy range 70 to 110 MeV. As a monitor process the electron Compton-scattering was simultaneously measured. The values of the electric ($\bar{\alpha}$) and the magnetic ($\bar{\beta}$) polarizabilities of the proton were obtained from the experimental data: $\bar{\alpha}$ $(10.7 \pm 1.1) \times 10^{-43}$ cm^3; $\bar{\beta} = (-0.7 \pm 1.6) \times 10^{-43}$ cm^3. (auth)

9688 POLARIZED TARGET ASYMMETRY IN π^+ PHOTOPRODUCTION BETWEEN 0.3 AND 1.0 GeV at 130°. Feller, P.; Fukushima, M.; Horikawa, N.; Kajikawa, R.; Mori, K.; Nakanishi, T.; Ohshima, T.; Pak, C. O.; Saito, M.; Suzuki, S. (Nagoya Univ. (Japan). Dept. of Phys. Lett., B; 52: No. 1, 105-107(16 Sep 1974).

The polarized target asymmetry in the reaction $\gamma p \rightarrow \pi^+ n$ was measured at c.m. angles around 130° for photon energies between 0.3 and 1.0 GeV by detecting the π^+ only. The asymmetry is compared with recent analyses. (auth)

9689 COHERENT PHOTOPRODUCTION OF THE π^0 MESON ON DEUTERIUM. Bouquet, B.; Buon, J.; Grelaud, B.; N'guyen'-ngoc, H.; Petroff, P.; Riskalla, R.; Tchapoutian, R. (Paris-11 Univ., 91 – Orsay (France)). Nucl. Phys., B; 79: No. 1, 45-56 (11 Sep 1974).

The differential cross section of the reaction $\gamma d \rightarrow \pi^0 d$ was measured at constant momentum transfer, using a counter technique, in a large kinematical region, ranging from 240 to 1000 MeV/c momentum transfer and from 220 to 1400 MeV lab photon energy. (auth)

9690 PRODUCTION OF VECTOR MESONS BY MUONS IN A HYBRID BUBBLE–CHAMBER EXPERIMENT. Ballam, J.; Bloom, E.D.; Carroll, J.T.; Chadwick, G.B.; Cottrell, R.L.A.; Della Negra, M.; DeStaebler, H.; Gershwin, L.K.; Keller, L.P.; Mestayer, M.D.; Moffeit, K.C.; Prescott, C.Y.; Stein, S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 3, 765-775 (1 Aug 1974).

We present results on vector–meson leptoproduction in the SLAC fast–cycling 40–in. hydrogen bubble chamber exposed to 16–GeV/c muons. From 3644 inelastic events we obtained 495 events of $\mu^- p \rightarrow \mu^- \pi^+ \pi^- p$ of which approximately 160 are ρ events with $W > 2$ GeV and $Q^2 > 0.05$ GeV^2. Analyzing this data in the same way as in our previous photoproduction experiment, we find the ρ^0 contribution to σ_{tot} decreases by about 35% between $Q^2 = 0$ and 1 GeV^2, and the exponential slope parameter becomes approximately 20% smaller, although within errors it is still consistent with the photoproduction value. The decay angular distribution of the ρ^0 shows a substantial $\cos^2 \theta$ component which can be interpreted as evidence for production by longitudinal photons assuming s–channel helicity is conserved. Data from 39 ω–production events is also presented. Upper limits for ϕ and ρ' production are given. (auth)

9691 POSSIBLE NUCLEON RESONANCE ADMIXTURE IN THE DEUTERON. Benz, P.; Soeding, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Phys. Lett., B; 52: No. 3, 367-371(14 Oct 1974).

Low-energy, apparently resonant $p\pi^+$ systems are found to emerge when deuterons are struck by high-energy photons. These could be $\Delta(1236)$ "spectators" set free from a hypothetical virtual $\Delta\Delta$ state of the deuteron occurring with ~3% probability. The possibility of other interpretations of this observation is also explored. (auth)

9692 THE TWO-PHOTON PROCESS FOR PARTICLE PRODUCTION IN COLLIDING BEAM EXPERIMENTS. Grammer, G. Jr.; Kinoshita, T. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Nuclear Studies). Nucl. Phys., B; 80: No. 3, 461-490(18 Oct 1974).

Cross sections for particle production by the two-photon process for the reactions $ee \rightarrow ee\ X$ with $X = \pi^0$ or η and $X = \pi^+\pi^-$ or $\mu^+\mu^-$ are calculated exactly by numerical techniques and are compared with predictions of the double equivalent photon approximation (DEPA). Implications of these results as to the validity of the DEPA are discussed and an attempt is made to summarize and clarify some of the earlier criticisms of this approximation. (auth)

Weak

Refer also to abstract 9604.

9693 (KEK-73-10, pp 113-140) EXPERIMENTS OF WEAK INTERACTION "NEUTRINO REACTION." Nagashima, Y. Dec 1973.

From proceedings for high energy physics; Ibaraki, Japan (17 Jul 1973).

The discussion covers the weak Hamiltonian, the kinematics of the lepton–hadron interaction, the parton model and electron data. Neutrino experiments at CERN and NAL are discussed including total cross sections, the ratio $\sigma\bar{\nu}/\sigma\nu$, the Y distribution, problems of high energy neutrino interactions, the neutrino beam, search for the W boson and for heavy leptons, and the CALTECH–NAL experiment. (JFP)

9694 (UCI-10-P19-88) RESEARCH PROGRAM IN NEUTRINO PHYSICS, COSMIC RAYS, AND ELEMENTARY PARTICLES, 1 OCTOBER 1973–30 SEPTEMBER 1974. Reines, F. (California Univ., Irvine (USA)). Aug 1974. Contract AT(11-1)-Gen-10. 81p. Dep. NTIS $7.25.

The research being conducted under this contract centers on neutrinos at reactors and in the cosmic rays. In addition we have completed equipment for a study of double beta decay and made progress with instrumentation for ultra low background studies. Measurements have shown the suitability of the salt mine laboratory as a location for continuation of extra-terrestrial neutrino search and low background studies. Preparations are being made for an experimental test for the existence of an advanced potential in electromagnetic radiation. The elastic scattering detector at Savannah River was successfully rebuilt reducing the radioactive background by a factor of ~10 representing a considerable advance in the art of low background counting. The result with the system prior to rebuilding is now (σ expt'l/σ V-A) = 1.4 ± .7, providing analysis of data in hand confirms the expectation that the reactor associated background from neutrons and gammas is small. A neutral current experiment in which a fission $\bar{\nu}_e$ causes the reaction $\bar{\nu}_e + d \rightarrow n + p + \bar{\nu}_e$ is in process of preparation. Preliminary measurements at SRP have demonstrated feasibility. New limits for baryon conservation were obtained from an analysis of the stopping muons in the South African detector. The lifetime for decay modes in which a muon is produced is $> 2 \times 10^{30}$ years/nucleon. (auth)

9695 MEASUREMENT OF THE K_S BRANCHING RATIO INTO TWO PIONS. Cowell, P.; Lee–Franzini, J.; Orcutt, R. (State University of New York at Stony Brook, Stony Brook, New York 11790); Franzini, P.; Newman, R.; Zubarik, S. Phys. Rev. D 10: No. 7, 2083-2090 (1 Oct 1974).

A spark–chamber experiment to measure the branching ratio of the short–lived K_1 meson into the modes $\pi^+\pi^-$ and $\pi^0\pi^0$ was performed at the Princeton–Pennsylvania Accelerator. A 1.0–GeV/c beam of incident π^- mesons produced Λ^0K^0 from a polyethylene target. The decay of Λ into π^-p was used as a signal for the associated production of a K^0. A total of 160000 pictures, taken in two views, were completely scanned for V's (charged decays of neutral particles), and all tracks were measured. A final sample of 16000 K_1 charged decays and 65000 Λ^0 charged decays directly determined the branching fraction for K_1 to decay into $\pi^+\pi^-$ to be 0.684 ± 0.009. The branching ratio found by this experiment is then $\Gamma(K_1 \rightarrow \pi^+\pi^-) / \Gamma(K_1 \rightarrow \pi^0\pi^0) = 2.169 \pm 0.094$. (auth)

9696 SEARCH FOR THE RARE DECAY $K^+ \rightarrow \pi^+e^+e^-$. Clarke, D.B.; Cline, D.B.; Frommer, R. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); Cence, R.J.; Harris, F.A.; Jones, B.D.; Morgado, R.E.; Peters, M.W.; Shiraishi, L.M.; Yount, D.E.; Gauld, B.; Perez–Mendez, V. Phys. Rev. D 10: No. 3, 776-783 (1 Aug 1974).

A search for the rare decay $K^+ \rightarrow \pi^+e^+e^-$ has been carried out at the Lawrence Berkeley Laboratory using a sparkostrictive wire–chamber spectrometer. Analysis programs identified events with three tracks or with two tracks of which one was an electron and the other a positron. Analysis of the three–track events yields a branching ratio $\Gamma(K^+ \rightarrow \pi^+e^+e^-)/\Gamma(K^+ \rightarrow \text{all}) < 1.7 \times 10^{-6}$ (90% confidence). The two–track events, analyzed by searching for sparks on a possible pion track, yield a limit of $\Gamma(K^+ \rightarrow \pi^+e^+e^-)/\Gamma(K^+ \rightarrow \text{all}) < 2.7 \times 10^{-7}$ (90% confidence). The latter value implies that the coupling constant for a vector neutral current must be about three orders of magnitude smaller than the coupling constant for the charged vector current. (auth)

9697 MEASUREMENT OF THE MAGNETIC MOMENT AND OF THE DECAY PARAMETERS OF THE Ξ^- HYPERON. Cool, R.L.; Giacomelli, G.; Jenkins, E.W.; Kycia, T.F.; Leontic, B.A.; Li, K.K.; Teiger, J. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 10: No. 3, 792-810 (1 Aug 1974).

A measurement of the magnetic moment and of the decay parameters of the Ξ^- hyperon is reported. The measurement gave $\mu_\Xi = (-2.1 \pm 0.8)$ nuclear magnetons, corresponding to a gyromagnetic ratio of $g_\Xi = 4.2 \pm 1.6$. The measured Ξ decay parameters are $\varphi_\Xi = -0.39 \pm 0.05$ $\beta_\Xi = 0.08 \pm 0.26$, γ_Ξ 0.92 ± 0.03 ($\phi_\Xi = 5^\circ \pm 16^\circ$); and the lifetime $\tau_\Xi = (1.637 \pm 0.050) \times 10^{-10}$ sec. In the accepted angular range for the production of the Ξ^- (about $4.2^\circ < \theta_{lab} < 11.5^\circ$), in the reaction $K^- + p \rightarrow K^+ + \Xi^-$ the polarization of the Ξ^-, is 0.29 ± 0.10, 0.44 ± 0.09, 0.36 ± 0.10, and 0.21 ± 0.06, at laboratory momenta of 1.74, 1.80, 1.87, and 1.83 GeV/c, respectively. (auth)

9698 A NEW LIMIT ON THE DECAY $\mu^+ \rightarrow e^+ + \gamma + \gamma$. Poutissou, J. M. (Montreal Univ., Quebec (Canada)); Felawka, L.; Ingram, C. H. Q.; MacDonald, R.; Measday, D. F.; Salomon, M.; Spuller, J. (British Columbia Univ., Vancouver (Canada)). Nucl. Phys., B; 80: No. 2, 221-229(11 Oct 1974).

A search has been made for the "forbidden" decay $\mu^+ \rightarrow e^+ + \gamma + \gamma$. With a confidence limit of 90%, the branching ratio is found to be less than 4×10^{-8}, which is one-fourth as large as previous measurements. (auth)

9699 RESULTS OF MUON INTERACTIONS AT GREAT DEPTH AND GREAT ZENITHAL ANGLES. Baschiera, B.; Bergamasco, L.; Picchi, P. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 54: No. 3, 447-450(Mar 1973).

Results on the $\mu - e$ decay and the neutron production events induced by the horizontal muons are reported. The muon interaction cross sections from neutron production by horizontal muons are found. It is concluded that these preliminary results on the rates and distribution of the horizontal events suggest some new kind of process with energy transfers and particle multiplicities higher than those given by the conventional processes. The possibility of the Weinberg W meson which would coherently explain several anomalous results obtained in cosmic ray experiments is suggested. (JFP)

Strong (Baryon-induced)

Refer also to abstracts 9829, 9985, 10013, and 10217.

9700 (COO-881-413) TOTAL CROSS SECTIONS AND HIGH p_T-PHENOMENA ABOVE ISR ENERGIES. Halzen, F. (Wisconsin Univ., Madison (USA). Dept. of Physics). 1974. 27p. (CONF-740675-1). Dep. NTIS $4.50.

From general meeting of the American Physical Society; Salt Lake City, Utah USA (12 Jun 1974).

The discovery of rising total cross sections and a component of the proton–proton interaction yielding an unexpected number of high transverse momentum secondaries growing with energy, raises novel questions about the nature of hadronic collisions. It is unlikely that these questions will be resolved without cross section measurements over several orders of magnitude in energy above the NAL-ISR range. It is pointed out that very crucial hints about the physics of total cross sections and high p_T secondaries can be obtained from cosmic ray experiments despite the low intensity of ultra high energy cosmic rays. (auth)

9701 (COO-2009-86) STRUCTURES IN PROTON–PROTON ELASTIC SCATTERING (MAINLY AT ARGONNE ZGS ENERGIES), AND THEIR INTERPRETATION. Hendry, A. W. (Indiana Univ., Bloomington (USA)). 1974. 24p. (CONF-740733-1). Dep. NTIS $4.25.

From ZGS workshop; Argonne, Illinois, USA (22 Jul 1974).

Experimentally, there is clear structure in $d\sigma/dt$ versus t for elastic PP scattering at values $-t \approx 1, 3\ (\text{GeV}/c)^2$ (from the slope); in polarization versus t at values $-t \approx 0.8, 2.5, 5.5\ (\text{GeV}/c)^2$ (dips or double zeros); and in fixed angle $(d\sigma/dt)_\theta$ versus t again at $-t \approx 1, 3, 6 \ldots (\text{GeV}/c)^2$. All of these structures seem to arise naturally from the oscillations of amplitudes which are dominated by diffractive and peripheral contributions. The s-channel presents a simple physical picture for the scattering process, and provides a straightforward interpretation of the observed structures. (auth)

9702 (COO-3065-94) LOW MOMENTUM TRANSFER PROTON–PROTON ELASTIC SCATTERING UP TO 400 GeV. Gross, D. A. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). 1974. Contract AT(11-1)-3065. 215p. (UR-503). Dep. NTIS $13.75.

Thesis.

A hydrogen jet target was used to study pp scattering. The target was installed in the internal beam of the N.A.L. Accelerator. Solid state detectors were used to detect the low energy recoils, close to 90° from the forward direction. A total of about 14×10^6 elastic events, equally divided between the two phases of the experiment, were obtained in the study of the low momentum transfer scattering. The forward diffraction peak (in the range $0.004 < -t < 0.2\ (\text{GeV}/c)^2$) and the real-to-imaginary ratio (in the range $0.001 < -t < 0.04\ (\text{GeV}/c)^2$) of the nuclear scattering amplitude energy dependence were derived in the range 40 to 400 GeV/c, laboratory momentum. The results indicate a continuing shrinkage of the forward peak, even if at a reduced rate from Serpukhov energies. The zero-crossing of the real-to-imaginary ratio at about 300 GeV is strong evidence for the rise in the total cross section in the N.A.L.-I.S.R. energy region. (auth)

9703 (KEK-73-10, pp 1-47) RECENT ISR EXPERIMENTS AT CERN. Erne, F. C. Dec 1973.

From proceedings for high energy physics; Ibaraki, Japan (17 Jul 1973).

Research on ISR experiments is summarized including the motivation for building storage rings, the operation of the ISR and luminosity measurements, and some measurements and physical results for strong interactions. (JFP)

9704 RECENT ADVANCES IN PARTICLE PHYSICS. Van Hove, L. CERN Cour.; 10: No. 14, 331-333(Oct 1974).

The discussion of recent advances in particle physics covers classes of proton-proton collisions at high energies, electron-nucleon and neutrino-nucleon collisions, and other properties of proton-proton collisions including large transverse momentum and total cross sections. (JFP)

9705 EVIDENCE FOR COHERENT EFFECTS IN LARGE–ANGLE HADRON–HADRON SCATTERING. Hendry, A.W. (Physics Department, Indiana University, Bloomington, Indiana 47401). Phys. Rev. D 10: No. 7, 2300-2303 (1 Oct 1974).

We suggest, by looking at p p and π^+p elastic data, that the evidence for the parton prediction $d\sigma/dt \sim s^{-n}f(\theta)$ is not as convincing as is generally supposed. We also draw attention to the presence of well–defined structures in $(d\sigma/dt)_\theta$; these may well reveal a strong component of conventional coherent scattering effects, even at large angles. (auth)

9706 pp INTERACTIONS AT 300 GeV/c: MEASUREMENT OF THE CHARGED–PARTICLE MULTIPLICITY AND THE TOTAL AND ELASTIC CROSS SECTIONS. Firestone, A.; Davidson, V.; Lam, D.; Nagy, F.; Peck, C.; Sheng, A. (California Institute of Technology, Pasadena, California 91109); Dao, F.T.; Hanft, R.; Lach, J.; Malamud, E.; Nezrick, F.; Dzierba, A.; Poster, R.; Schlein, P.; Slater, W. Phys. Rev. D 10: No. 7, 2080-2083 (1 Oct 1974).

In a 35000–picture exposure of the 30–in. hydrogen bubble chamber to a 300–GeV/c proton beam at the National Accelerator Laboratory, 10054 interactions have been observed. The measured total cross section is 40.68 ± 0.55 mb, the elastic cross section is 7.89 ± 0.52 mb, and the average charged–particle multiplicity for inelastic events is 8.50 ± 0.12. (auth)

9707 SEARCH FOR Ξ^{*-}, Σ^{*-}, AND Ω^- PRODUCTION BY NEGATIVE HYPERONS ON NUCLEI. Hungerbühler, V.; Majka, R.; Marx, J.N.; Némethy, P.; Sandweiss, J.; Tanenbaum, W.; Willis, W.J. (Yale University, New Haven, Connecticut 06520); Atac, M.; Ecklund, S.; Gollon, P.J.; Lach, J.; MacLachlan, J.; Roberts, A.; Stefanski, R.; Theriot, D.; Wang, C.L.; Cleland, W.; Engels, E. Jr.; Lowenstein, D.I.; Scribner, N.; Thompson, J. Phys. Rev. D 10: No. 7, 2051-2055 (1 Oct 1974).

The reactions of 24.6–GeV/c Σ^- and Ξ^- incident on a scintillator target were studied in a counter–spark chamber experiment. Upper limits on the production cross section of Σ^{*-} resonances which decay into $\Lambda^0\pi^-$ and of Ξ^{*-} resonances which decay into Λ^0K^- were obtained. A single Ω^- that was produced in the scintillator target has been observed, corresponding to a 115–μb/nucleon production cross section if produced by a Ξ^-. The $\Lambda^0\pi^-$ mass spectrum was found to be consistent with a Deck–type threshold enhancement. (auth)

9708 PROTON DIFFRACTION DISSOCIATION STUDIES AT THE CERN ISR. Boehm, A.; Bozzo, M.; Ellis, R.; Ferrero, M. I.; Foeth, H.; Goldharber, G.; Hansroul, M.; Kernan, A.; Maderni, G.; Naroska, B. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.). Nucl. Phys., B; 79: No. 1, 1-9(11 Sep 1974).

Proton diffraction dissociation was studied at the ISR with a double-arm magnetic spectrometer close to the forward directions of the two ISR beams. Events with a single charged particle in one spectrometer and a jet in the opposite direction were found to be predominantly diffraction dissociation. In these events a positive correlation was observed between the mass and decay multiplicity of the fireball. The shape of the diffractive mass spectrum and its consistency with triple pomeron coupling were investigated at $\sqrt{s}$ = 31, 45, and 53.4 GeV. (auth)

9709 CHARGED MULTIPLICITY DISTRIBUTIONS AND NEUTRAL PARTICLE PRODUCTION IN 14.75 GeV/c $\bar{p}p$ INTERACTIONS. Dao, F. T.; Lach, J.; Whitmore, J. (National Accelerator Lab., Batavia, Ill. (USA)). Phys. Lett., B; 51: No. 5, 505-508(2 Sep 1974).

From an exposure of the Brookhaven National Laboratory 80-inch hydrogen bubble chamber to a 14.75-GeV/c separated anti-proton beam, an average charged particle multiplicity of 4.12 ± 0.06 was determined. The inclusive production of γ, K_s^0, and Λ^0 particles was also studied. The correlations between $\pi^\pm$ and π^0, K_s^0, or Λ^0 are described, and the strong correlation observed between $\pi^\pm$ and π^0 is contrasted to the apparent lack of correlation found in other hadron–hadron interactions at similar beam momenta. Invariant cross sections for γ, K_s^0, and Λ^0 production are presented as a function of x. (auth)

9710 INTRANUCLEAR CASCADING IN PHOTOGRAPHIC EMULSION AT ACCELERATOR AND COSMIC–RAY ENERGIES. Gibbs, R.E. (Department of Physics, Eastern Washington State College, Cheney, Washington 99004); Florian, J.R.; Kirkpatrick, L.D.; Lord, J.J.; Martin, J.W. Phys. Rev. D 10: No. 3, 783-792 (1 Aug 1974).

The data on the interactions of cosmic–ray protons in nuclear emulsion have been analyzed in light of the results of recent exposures of emulsion to accelerator protons. Plots of $\langle \log_{10} \tan \theta \rangle$ as a function of the number of evaporation prongs, N_h, display an energy–independent behavior which is exploited to determine the energies of cosmic–ray events. It is found that the energies quoted in the literature are generally too high. The average charged multiplicity is linearly related to N_h from 30 GeV to 5 TeV. While a model of nuclear cascading based on direct production is consistent with these data from 30 GeV to 500 GeV, a model proceeding through an intermediate state gives better agreement at cosmic–ray energies. (auth)

9711 CHARGED PARTICLE PRODUCTION IN PROTON-PROTON INCLUSIVE REACTIONS AT VERY HIGH ENERGIES. Capiluppi, P.; Giacomelli, G.; Rossi, A. M.; Vannini, G. (Bologna Univ. (Italy). Istituto di Fisica); Bertin, A.; Bussiere, A.; Ellis, R. J. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 79: No. 2, 189-258(18 Sep 1974).

Experimental results on the production of charged particles in proton-proton inclusive reactions at intermediate angles (80 to 350 mrad) and in the momentum range of 1.5 to 10 GeV/c at the CERN ISR are reported. The data are presented as a function of the longitudinal variables x and y_{lab}, and of the transverse momentum p_t. For each type of observed particle the experimental distributions and their energy dependence are discussed. (auth)

9712 DIFFRACTION DISSOCIATION OF NEUTRONS IN THE REACTION dp → pppπ^- AT 25 GeV/c. Cooper, J. W.; Seidl, A. A.; Vander Velde, J. C. (Michigan Univ., Ann Arbor (USA)). Nucl. Phys., B; 79: No. 2, 259-275(18 Sep 1974).

The reaction dp → $p_{spec}(p\pi^-)p$ is observed in a bubble chamber exposure at 25 GeV/c incident deuteron momentum. The $(p\pi^-)$ system with invariant mass below 2.0 GeV is interpreted as neutron diffraction dissociation. The $(p\pi^-)$ mass spectra show little if any direct evidence of N* production. The decay angular distributions and the momentum transfer distributions of the $(p\pi^-)$ system suggest a smooth increase in contributions from higher partial waves ($J \geq 3/2$) with increased mass or momentum transfer. A simple partial-wave analysis shows a P_{11} contribution below 1.3 GeV for small $-t'$ and a dominant D_{13} contribution elsewhere. Both the P_{11} and D_{13} amplitudes peak far below the N* (1470) and N*(1520) resonances. Evidence is also found for the charge-exchange reaction np → $p(p\pi^-)$. In this process the $(p\pi^-)$ system shows evidence for $\Delta^0(1236)$ and N*(1520) production. (auth)

9713 TWO-PION PRODUCTION IN pn COLLISIONS AT 11.6 GeV/c. Hochman, D.; Eisenberg, Y.; Karshon, U.; Shapira, A.; Ronat, E. E.; Yaffe, D.; Yekutieli, G. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics); Hammerman, I.; Goldberg, J. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). Nucl. Phys., B; 80: No. 2, 189-205(11 Oct 1974).

Two-pion production in pn reactions is studied in pd collisions at 11.6 GeV/c. In particular the final state $pn\pi^+\pi^-$ is analyzed. A cross section of $\sigma = 0.68 \pm 0.07$ mb is found for the reaction pn → $\Delta^{2+}\Delta^-$. By using other data at different energies and assuming I = 1 exchange dominates, the energy dependence of this channel is given by $p_{LAB}^{-1.5}$. The t' distribution for $\Delta^{2+}\Delta^-$ is described by an absorptive one-pion exchange model. The cross section of the exotic exchange reaction pn → $\Delta^-\Delta^{2+}$ (with forward Δ^-) has a two-standard-deviation upper limit of 19 μb. The final states $\Delta^{2+}\pi^-n$ and $\Delta^-\pi^+p$ are in agreement with a double Regge pole model with pion and pomeron exchanges. A reggeized one-pion exchange model using experimental πp phase-shift parameters accounts for the gross features of the $pn\pi^+\pi^-$ final state with the p forward and the n backward in the c.m. (auth)

9714 SINGLE-PION PRODUCTION IN pn COLLISIONS AT 11.6 GeV/c. Hochman, D.; Eisenberg, Y.; Karshon, U.; Shapira, A.; Ronat, E. E.; Yaffe, D.; Yekutieli, G.; Saltzman, D. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics). Nucl. Phys., B; 80: No. 1, 45-60(4 Oct 1974).

The process pn → $pp\pi^-$ is studied in pd collisions at 11.6 GeV/c. A broad low-mass enhancement of $p\pi^-$ is found in the diffractive reaction pn → $p(p\pi^-)$ with a cross section slightly smaller than that of a similar analysis at 7.0 GeV/c. The non-diffractive reaction pn → $(p\pi^-)p$ shows some evidence for resonance production, and its cross-section dependence on energy is characteristic of meson exchange. Samples of mass, momentum transfer, and decay angular distributions are compared with the predictions of a double Regge model and a reggeized one-pion exchange model. By using in addition information from the reactions pp → $pp\pi^0$, pp → $pn\pi^+$ at 12.0 GeV/c, an isospin analysis of the single-pion production reaction from nucleon–nucleon scattering, $N_1N_2 \rightarrow N_3(N_4\pi)$, is presented. (auth)

9715 LABORATORY ANGULAR DISTRIBUTIONS FOR THE PRODUCTION OF CHARGED SECONDARIES IN INELASTIC PROTON–PROTON COLLISIONS AT 102 GeV/c. Cooper, J.; Seidl, A.; Vander Velde, J. C. (Michigan Univ., Ann Arbor (USA)); Bromberg, C.; Cohen, D.; De Brion, J. P.; Ferbel, T.; Slattery, P. (Rochester Univ., N. Y. (USA)). Nucl. Phys., B; 80: No. 2, 239-246(11 Oct 1974).

Lab angular distributions for the production of charged secondary particles in inelastic proton–proton collisions are presented. Data are separately displayed for protons and for positive and negative mesons (pions and kaons combined). (auth)

Strong (Meson-induced)

Refer also to abstract 9828.

9716 (KEK-73-10, pp 49-74) DETECTION OF NEUTRAL PARTICLES IN HIGH ENERGY EXPERIMENTS. Yasumi, S. Dec 1973.

From proceedings for high energy physics; Ibaraki, Japan (17 Jul 1973).

The lecture on the detection of neutral particles covers the classification of neutral particles from the viewpoint of the detection method, neutrons, photons, and neutral pions and eta mesons. (JFP)

9717 (KEK-73-10, pp 203-238) POLARIZATION EXPERIMENTS IN HIGH ENERGY PION-NUCLEON ELASTIC SCATTERING. Van Rossum, L. (CEN, Saclay, France). Dec 1973.

From proceedings for high energy physics; Ibaraki, Japan (17 Jul 1973).

The topics treated are the CERN experiments on polarization and spin-rotation at 6 GeV/c (1967 to 1971), amplitude analysis of πN scattering at 6 and 16 GeV/c, and the Serpukhov polarization experiment (1971 to 1974). (JFP)

9718 $\pi^+\pi^+ \rightarrow \pi^+\pi^+$ SCATTERING BELOW 0.7 GeV FROM $\pi^+p \rightarrow \pi^+\pi^+n$ AT 5 GeV/c. Prukop, J.P.; Sander, O.R.; Poirer, J.A.; Rey, C.A.; Lennox, A.J.; Chen, B.C.; Biswas, N.N.; Cason, N.M.; Kenney, V.P.; Shephard, W.D. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556); Klem, R.D.; Spirn, I. Phys. Rev. D 10: No. 7, 2055-2069 (1 Oct 1974).

Magnetostrictive spark chambers were used with a large magnet spectrometer to study the reaction $\pi^+p \rightarrow \pi^+\pi^+n$ at 5.0 GeV/c at Argonne National Laboratory. We measured differential cross sections for this reaction in the region of low nucleon momentum transfer and by extrapolation obtained cross sections and phase shifts for the reaction $\pi^+\pi^+ \rightarrow \pi^+\pi^+$ in the region of dipion mass less than 0.7 GeV. Effects of the interference between the strong $\pi^+\pi^+$ amplitude and the Coulomb amplitude off the mass shell were investigated and were found to be small. The S-wave phase shifts for $\pi^+\pi^+$ scattering near threshold were parameterized in terms of a scattering parameter, a_2, and an effective range, r_2; the D wave by a scattering length, b_2. The fits obtained by extrapolation techniques were insensitive to b_2 and gave $a_2 = -0.24 \pm 0.02$ F and $r_2 = -1.0 \pm 1.7$ F, where the error quoted is statistical. The fits obtained by off-shell fitting gave $a_2 = -0.22 \pm 0.04$ F, $r_2 = -0.34^{+0.9}_{-1.2}$ F, and $b_2 = -0.0041^{+0.0025}_{-0.0021}$ F^5. These results for a_2 are inconsistent with a number of theoretical calculations. (auth)

9719 $\pi\pi$ SCATTERING IN THE ENERGY REGION 0.6 TO 1.42 GeV. Engler, A.; Kraemer, R.W.; Toaff, S.; Weisser, F. (Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213); Diaz, J.; DiBianca, F.A.; Fickinger, W.J.; Robinson, D.K. Phys. Rev. D 10: No. 7, 2070-2079 (1 Oct 1974).

$\pi\pi$ scattering amplitudes have been determined in the energy range 0.6 to 1.42 GeV. The amplitudes have been extracted in the framework of an absorption-modified one-pion-exchange model with certain energy-dependent assumptions. (auth)

9720 LINE REVERSAL, SU_3 AND EXCHANGE DEGENERACY IN $K^{\pm}N$ CHARGE EXCHANGE AT 4 GeV/c. Elvekjaer, F.; Johnson, R. C. (CERN, Geneva). Lett. Nuovo Cim.; 11: No. 12, 561-567(23 Nov 1974).

Some immediate features of accurate new K^+ (K^-) charge-exchange cross sections at 4 GeV/c are discussed. They are consistent with SU(3) octet symmetry for helicity-flip ρ and A_2 quantum-number exchange. There is evidence for SU (3) couplings of the ρ in both flip and nonflip. The sizeable breaking of line reversal symmetry is not consistent with the standard model which blames the s-channel helicity-nonflip amplitude while supposing that the flip amplitude is exchange degenerate and Regge polelike. A model of α broken exchange degeneracy poles may work for the flip amplitude. (JFP)

9721 SPIN-PARITY OF THE $\Sigma(1580)$. Litchfield, P. J. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 51: No. 5, 509-511(2 Sep 1974).

Recent measurements of the $\bar{K}N$ total cross sections have disclosed the presence of a narrow peak at around 1580 MeV in the I = 1 cross section. A re-analysis of data on the reaction $K^-p \rightarrow \Lambda\pi^0$ in this region confirms the resonant structure, and measures its spin-parity to be $^3/_2{}^-$, its mass to be 1582 ± 4 MeV, and its width to be 11 ± 4 MeV. (auth)

9722 NEUTRAL STRANGE PARTICLE PRODUCTION IN π^-p, π^-n AND π^-C INTERACTIONS AT 40 GeV/c. Balea, O.; Boldea, V.; Felea, S.; Ponta, T. (Institutul de Fizica Atomica, Bucharest (Romania)); Gemesy, T.; Haydu, K.; Jenik, L.; Kiss, D.; Kraszнovsky, S.; Pinter, G. Nucl. Phys., B; 79: No. 1, 57-69(11 Sep 1974).

Results on the inclusive and topological cross sections for Λ and K^0 particles produced in π^-p, π^-n, and π^-C interactions at 40 GeV/c are reported. The $\sigma^{\pi^-p}_{\Lambda(\Sigma^0)}$ value increases twofold from 25 to 40 GeV/c while $\sigma^{\pi^-p}_{K\bar{K}}$ increases continuously with the incident momentum. The invariant single-particle distributions in the x and $p_\perp^2$ variables for K_1^0 and Λ particles are presented and compared with the respective ones for π^-p interactions at lower energies as well as for pp interactions at 200 to 300 GeV/c. (auth)

9723 PHOTOPRODUCTION OF ρ^0, ω AND ρ^- MESONS ON DEUTERONS AT ENERGIES BETWEEN 1 AND 5 GeV. Benz, P.; Butenschoen, H.; Gall, D.; Knies, G.; Soeding, P.; Storim, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Braun, O.; Schnackers, H. J.; Stiewe, J. (Heidelberg Univ. (F. R. Germany). Inst. fuer Hochenergiephysik); Idschok, U. Nucl. Phys., B; 79: No. 1, 10-37(11 Sep 1974).

The reactions $\gamma d \rightarrow \rho^0 d$, $\gamma d \rightarrow \omega d$ and $\gamma n \rightarrow \rho^- p$ were investigated in a deuterium bubble chamber experiment at DESY with a bremsstrahlung beam of 5.5 GeV maximum energy. Effective mass distributions as well as total and differential cross sections are presented. The results are compared with ρ^0 and ω production on protons. (auth)

9724 MEASUREMENT OF THE KAON MASS DIFFERENCE $m_L - m_S$ BY THE TWO REGENERATOR METHOD. Geweniger, C.; Gjesdal, S.; Presser, G.; Steffen, P.; Steinberger, J.; Vannucci, F.; Wahl, H. (European Organization for Nuclear Research, Geneva (Switzerland)); Eisele, F.; Lueth, V Zech, G. (Heidelberg Univ. (F. R. Germany). Inst. fuer Hochenergiephysik). Phys. Lett., B; 52: No. 1, 108-112(16 Sep 1974).

The result of a measurement of the mass difference $\Delta m = m_L - m_S$, where m_L and m_S are the masses of the long and short lived neutral kaons respectively. The method consists of the comparison of the intensity of the K_S regenerated from a K_L beam in two slabs of matter separated at different distances. The result is: $\Delta m = m_{KL} - m_{KS} = (0.534 \pm 0.003) \times 10^{10}$ sec^{-1}. (auth)

9725 A MEASUREMENT OF THE $K_L - K_S$ MASS DIFFERENCE FROM THE CHARGE ASYMMETRY IN SEMI-LEPTONIC KAON DECAYS. Gjesdal, S.; Presser, G.; Kamae, T.; Steffen, P.; Steinberger, J.; Vannucci, F.; Wahl, H. (European Organization for Nuclear Research, Geneva (Switzerland)); Eisele, F.; Filthuth, H.; Lueth, V. Phys. Lett., B; 52: No. 1, 113-118(16 Sep 1974).

The charge asymmetry in semi-leptonic kaon decays was measured as a function of the kaon lifetime. High statistics data of K^0_{e3} and $K^0_{\mu 3}$ decay modes agree with each other and with the general expectation of the CP violation phenomenology together with the $\Delta S - \Delta Q$ rule. The $K_L - K_S$ mass difference obtained is $\Delta M = (0.533 \pm 0.004) \times 10^{10}$ S^{-1}. (auth)

9726 η' (958) BRANCHING RATIO, LINEAR MATRIX ELEMENT, AND DIPION PHASE SHIFT. Kalbfleisch, G.R. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 10: No. 3, 916-920 (1 Aug 1974).

The "world" data on η' (958) in regard to the branching ratio $R = (\pi^+\pi^-\gamma/\pi^+\pi^-\eta_N)$, η_N denoting η (549) → all neutrals, branching ratio (R), and the dipion mass spectrum in the $\eta' \rightarrow \pi^+\pi^-\eta$ decay are reviewed. We find that $R = 0.97 \pm 0.08$ independent of energy, exclusive of the data of Aguilar-Benitez et al. Under the assumption that $J^P = 0^-$, the best value of the α parameter of the linear matrix element is $\alpha = -0.08 \pm 0.03$. Possible connections between the dipion mass spectrum and δ_{00}, the $I = J = 0$ phase shift, are discussed. (auth)

9727 PARTIAL-WAVE ANALYSIS OF THE 3π SYSTEM PRODUCED IN THE REACTION $\pi^+p \rightarrow (\pi^+\pi^+\pi^-)p$ AT 8, 16 AND 23 GeV/c. Otter, G.; Rudolph, G.; Wieczorek, H. (Technische Hochschule Aachen (F.R. Germany). 3. Physikalisches Inst.); Boettcher, H.; Nowak, W. D. (SEE CODE- 7041274 Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic)); Boeckmann, K.; Plothow, H. (Bonn Univ. (F.R. Germany). Physikalisches Inst.); Cocconi, V. T.; Counihan, M. J.; Hansen, J. D. Nucl. Phys., B; 80: No. 1, 1-11(4 Oct 1974).

A partial-wave analysis has been made of the (3π) system produced in the reaction $\pi^+p \rightarrow (\pi^+\pi^+\pi^-)p$ at 8, 16, and 23 GeV/c by using the Illinois partial-wave analysis program. The (3π) system is in about 93% of the cases in the unnatural spin-parity states 0^-, 1^+, 2^- and 3^+, and is produced in about 100% of the cases by natural parity exchange. For all J^P states, the differential cross section $d\sigma/dt'$ peaks at small t', except for 2^+D, which has a dip at $t' \sim 0$. The cross sections for $J^P = 1^+$, 2^+ and 2^- in the A_1, A_2 and A_3 regions, respectively, all have similar energy dependence, p_{lab}^{-n}, with $n = 0.3 \pm 0.2$. The weak variation of the 1^+S phase across the 1.0-1.2 GeV mass region suggests that A_1 cannot be considered as a single resonance, while the phase variation of $2^+D(\rho\pi)$ in the A_2 mass region is consistent with resonance behavior. In the A_3 region, the behavior of the 2^-S and 2^-P phases is complex, and further work is needed to understand the mechanisms involved there. (auth)

9728 THE REACTIONS $\pi^{\pm}p \to p\pi^{\pm}\pi^{+}\pi^{-}$ AT 18.5 GeV/c. Lichtman, S.; Biswas, N. N.; Cason, N. M.; Kenney, V. P.; McGahan, J. T.; Shephard, W. D.; Smith, P. H. (Notre Dame Univ., Ind. (USA). Dept. of Physics). Nucl. Phys., B; 81: No. 1, 31-44(25 Oct 1974).

Studies were made of the reactions $\pi^+p \to p\pi^+\pi^+\pi^-$ and $\pi^-p \to p\pi^+\pi^-\pi^-$, both at an incident pion momentum of 18.5 GeV/c. The two-body (primarily Δ^{++} and ρ^0) and three-body (low mass A enhancement, A_3, N*(1400), and N*(1700)) subsystems are discussed. Cross sections for all significant channels of the reactions are given. (auth)

9729 $\bar{K}^*(890)$ PRODUCTION IN $K^-p \to NK\pi$ AT 16 GeV/c. Deutschmann, M.; Otter, G.; Rudolph, G. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Becker, L.; Lohmann, W.; Matthaeus, E.; Schreiber, H. J.; Weigt, G. (Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic)); Cocconi, V. T.; Hansen, J. D. Nucl. Phys., B; 81: No. 1, 1-17(25 Oct 1974).

Results on $\bar{K}^*(890)$ production in $K^-p \to NK\pi$ reactions at 16 GeV/c are presented. Total cross sections, differential cross sections and density matrix elements are determined. It is found that: The cross section for $K^{*-}(890)$ p is consistent with containing two components, one due to natural parity exchange, falling slowly with increasing energy, the other, due to unnatural parity exchange, vanishing rapidly with increasing energy. For $\bar{K}^{*0}(890)n$, the cross section decreases steadily as the energy increases. Natural spin-parity exchange dominates in the $K^{*-}(890)p$ channel, the unnatural exchange contribution being approximately (5 ± 4)%. In $\bar{K}^{*0}(890)n$, natural spin-parity exchange is only about (30 ± 10)%. The reaction $K^-p \to K^{*-}(890)p$ is dominated (95 ± 5)% by isoscalar exchange. The effective trajectory involved in the $I = 0$ natural parity exchange is consistent with the ω-f trajectory. Interference terms between exchanges with positive (f, π^0,. . .) and negative (ρ^0,ω,. . .) C-conjugation amount to (23 ± 12)μb at 16 GeV/c. (auth)

9730 ON STUDYING ENERGY DEPENDENCES OF π^-p ELASTIC SCATTERING CROSS SECTIONS IN THE 33-55 GeV/c RANGE. Derevshchikov, A. A.; Matulenko, Yu. A.; Mecshanin, A. P.; Mysnik, A. I.; Nurushev, S. B.; Proskurin, G. P.; Siksin, V. V.; Smirnov, E. V.; Soloviev, L. F.; Solovjanov, V. L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). Nucl. Phys., B; 80: No. 3, 442-460(18 Oct 1974).

The π^-p differential elastic scattering cross sections were measured for eight momenta in the 33 to 55 GeV/c range. The energy dependence of the slope and of the total elastic scattering cross sections was determined experimentally. The results are compared with the known data. The experimental data are compared both with the Regge pole model and with the quasi-potential one. (auth)

9731 A SEARCH FOR SPECTATOR ISOBARS IN DEUTERON COLLISIONS. Emms, M. J.; Kinson, J. B.; Stacey, B. J.; Votruba, M. F.; Woodworth, P. L. (Birmingham Univ. (UK)); Bell, I. G.; Dale, M.; Major, J. V. (Durham Univ. (UK)); Charlesworth, J. A.; Crennell, D. J. Phys. Lett., B; 52: No. 3, 372-374(14 Oct 1974).

A search has been made for spectator delta resonances from the breakup of deuterons by a 4-GeV/c incident π^+ beam. It is shown that the narrow $p\pi$ enhancement produced backwards in the laboratory system is mostly not Δ, and an upper limit of 0.8% is estimated for the $\Delta\Delta$ component of the deuteron. (auth)

9732 THE MISSING MASS SQUARED DEPENDENCE OF THE AVERAGE CHARGED PARTICLE MULTIPLICITY IN THE REACTION $K^+p \to K^0X^{++}$ FROM 5-16 GeV/c. Chliapnikov, P. V.; Gerdyukov, L. N.; Minaev, N. G.; Vorobjev, A. P.; (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij); Dunwoodie, W.; Goldschmidt-Clermont, Y.; Grant, A.; Sekera, Z.; Stergiou, A. Phys. Lett., B; 52: No. 3, 375-380(14 Oct 1974).

The average charged-particle multiplicity, $\langle n_{ch}(M_X^2)\rangle$, in the reaction $K^+p \to K^0X^{++}$ is studied as a function of the mass squared, M_X^2, of the recoil system, X, and also as a function of the K^0 transverse momentum, P_T, at incident momenta of 5.0, 8.2 and 16.0 GeV/c. The complete data samples yield distributions which are not independent of cm energy squared, s. They exhibit a linear dependence on log (M_X^2/M_0^2) $[M_0^2 = 1\ \mathrm{GeV}^2]$ with a change in slope occurring for $M_X^2 \sim s/2$, and do not agree with the corresponding distributions of $\langle n_{ch}\rangle$ as a function of s for K^+p inelastic scattering. Sub-samples of the data for which K^0 production via beam fragmentation, central production and target fragmentation are expected to be the dominant mechanisms show that, within error, the distribution of $\langle n_{ch}(M_X^2)\rangle$ versus M_X^2 is independent of incident momentum for each sub-sample separately. In particular in the beam fragmentation region the $\langle n_{ch}(M_X^2)\rangle$ versus M_X^2 distribution agrees rather well with that of $\langle n_{ch}\rangle$ versus s for inelastic K^+p interactions. The latter result agrees with recent results on the reactions $pp \to pX$ and $\pi^-p \to pX$ in the NAL energy range. Evidence is presented for the presence of different production mechanisms in these separate regions. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 10171.

9733 (COO-2232B-51) GAUGE THEORETIC BREAKTHROUGH. Beg, M. A. B. (Rockefeller Univ., New York (USA)). 1974. 31p. (CONF-740126-2). Dep. NTIS $4.75.

From theoretical studies conference; Coral Gables, Florida, USA (7 Jan 1974).

The discussion of the gauge theoretic breakthrough covers the state of weak interactions, the gauge alternative, models, and unsolved problems. (JFP)

9734 (DESY-74/41) CHARACTERIZATION OF PARTICLES BY LOCAL OBSERVABLES IN THE RELATIVISTIC QUANTUM THEORY. Enss, V. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Sep 1974. 27p. (In German). Dep. NTIS (US Sales Only) $4.50.

The notion of singly localized states is introduced and used to characterize the one-particle states as those states which are singly localized at all times. For theories which satisfy the Haag-Swieca compactness criterion, it is shown that a state has a discrete mass spectrum if and only if it is a "geometrical one particle state". Using a mathematical description of coincidence arrangements of counters, it is shown that in asymptotically complete theories the asymptotic particle number is the asymptotic number of localization centers. (auth)

9735 DESCRIPTION OF INCLUSIVE REACTIONS IN QUARK MODEL. Ezawa, Z. F.; Maharana, J.; Miyazawa, H. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 51: No. 3, 877-881(Mar 1974).

The additive quark model is extended to correlate various inclusive cross sections. A set of relations is obtained including those which relate cross sections in the negative x region with the positive x region, x being the Feynman variable. A selection rule is postulated which leads to further consequences in the fragmentation region. These predictions are in agreement with experimental data on pion production over a wide range of energies. (auth)

9736 GENERALIZED GAUGE CONDITIONS IN THE VIRASORO-SHAPIRO MODEL AND ELIMINATION OF GHOSTS. Kawati, S.; Konisi, G. (Kwansei Gakuin Univ., Nishinomiya, Japan). Progr. Theor. Phys. (Kyoto); 51: No. 4, 1131-1144(Apr 1974).

A proof for the no-ghost theorem of the Virasoro-Shapiro model is given without referring to the Virasoro conditions $[L_0^{\pm} - L_n^{\pm} - \alpha(0)/2]|\Phi\rangle = 0$ which do not hold. The crucial point for the proof is that there hold modified gauge conditions $\tilde{L}_n^{\pm}|\Phi\rangle = 0$ (n = 1, 2, . . .) where $\tilde{L}_n^{\pm}$ are the conformal group generators in the interacting case. The whole scheme is constructed based on the closed string loop model. (auth)

9737 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 20, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 91p.

9738 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 21, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 81p.

9739 ASYMPTOTIC FREEDOM AND THE LEE MODEL. Bender, C.M. (Department of Mathematics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Nash, C. Phys. Rev. D 10: No. 6, 1753-1759 (15 Sept 1974).

Using dimensional regularization we renormalize the Lee model in arbitrary space-time dimension D. We compute B(g) and γ (g), the coefficient functions of the Callan-Symanzik equation, in closed form and show that the model is asymptotically free when $D < 4$. In addition, we demonstrate a strict correlation between the sign of β (g) and the presence of a ghost state: There is no ghost when β (g) < 0. Finally, we study an extended Lee model with two coupling constants and study the behavior of the effective coupling constants in the deep–Euclidian region. (auth)

9740 LIFETIME OF ELEMENTARY PARTICLES FROM ANALYTIC CONTINUATION IN MOMENTUM AND INFINITE–COMPONENT WAVE EQUATIONS. Ram Mohan, L.R.; Tripathy, K.C. (Department of Physics, University of Delhi, Delhi–110007, India). Phys. Rev. D 10: No. 7, 2255-2259 (1 Oct 1974).

We derive the spin dependence of mass and of decay width of elementary particles described by infinite component fields transforming irreducibly under SL(2, C)(Majorana) $\otimes$ SL(2, C)(Dirac) $\times$ T_4 representations. The fields decscribing the unstable particles are certain operator--valued distributions whose Fourier transforms are defined in the complex–momentum space via analytic continuation, and classification under the nonunitary Poincaré group is used to characterize the decay widths. (auth)

9741 DUALITY. Phillips, R. J. W.; Roy, D. P. (Science Research Council, Chilton, Eng.). J. Phys., A (London); 37: No. 8, 1035-1097(1974).

In elementary particle physics, low energy interactions are characterized by resonance formation and high energy interactions by Regge pole exchanges: two quite different and apparently unrelated mechanisms. Duality is the hypothesis that they are in fact simply and quantitatively related. The present review describes the background and motivation for this hypothesis, and the different degrees of severity with which it can be formulated, together with some of its most notable predictions. Applications to the scattering amplitude are discussed; the most significant results being exchange degeneracy for high energy scattering and the Regge interpolation of resonances at low energy. Applications to particle classification are described. Duality constraints tie together several SU(3) multiplets, like a higher symmetry scheme; the exoticity prediction for the baryon-antibaryon channel is discussed in detail. Duality diagrams that provide a simple prescription for deriving most of the duality results are described. The Veneziano model, a simple form of amplitude that satisfies duality explicitly is considered; extensions to multiparticle scattering are also sketched. Finally applications of duality to the inclusive reaction, which is a field of immense activity at present, are discussed. The most significant results are again exchange degeneracy and the Regge interpolation of resonances–this time for the regions of high and low missing mass. (auth)

9742 CURRENT ALGEBRA AND THE NATURE OF THE POMERANCHUK MECHANISM. Craigie, N. S. (Hamburg Univ. (F. R. Germany). 2. Inst. fuer Theoretische Physik); Preparata, G. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 52: No. 1, 84–86(16 Sep 1974).

The fixed j-plane singularity at $j = 1$ in quark Green's functions implied by local current algebra is used as input in the Gribov Regge calculus to describe high energy hadron–hadron scattering. By including the two π intermediate state in the t channel, a moving pole with trajectory $\alpha_P(t) \sim 1.06 + 0.26\ t$, which appears to be a very good description of the Pomeranchuk mechanism up to the highest available energies, is obtained. (auth)

9743 ALGEBRA OF STRENGTHS GENERATED BY BILOCAL CURRENTS ACTING ON CONSTITUENT STATES. II. Universality. Reddy, V. T. N. (Texas Univ., Austin (USA)); Gomberoff, L.; Horwitz, L. P.; Ne'eman, Y. (Tel Aviv Univ. (Israel)). Phys. Lett., B; 52: No. 1, 74–78(16 Sep 1974).

Conditions necessary for the universality of factorized Regge residues are derived through the imposition of closure on Fourier transforms of the canonical algebra of quasi-bilocal currents in the deep Regge region. (auth)

9744 SUPER-SYMMETRIC V–A GAUGES AND FERMION NUMBER. Delbourgo, R.; Salam, A. (Imperial Coll. of Science and Technology, London (UK)); Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Phys. Lett., B; No. 5, 475–478(2 Sep 1974).

The discovery of super-symmetric Lagrangians which admit local internal symmetries leads one to expect that super-symmetry may play a role in unified theories of weak, electromagnetic and strong interactions. An outstanding problem in the search for realistic models has been the difficulty of incorporating a purely fermionic phase invariance which could be associated with the conservation of lepton or baryon number. In this note it is shown that one solution of the fermion-number conservation problem can be achieved in the context of models which carry a local vector as well as axial vector symmetry like SU(n) × SU(n). (NL)

9745 NARROW RESONANCES IN STATISTICAL MECHANICS. Dashen, R.F.; Rajaraman, R. (The Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 10: No. 2, 694-708 (15 July 1974).

It is shown that when the dynamics of a system is dominated by narrow–resonance formation it behaves like a noninteracting system with added species of free particles, corresponding to all the quantum numbers and the statistics of each of the resonances. This equivalence, widely assumed and used in practice, is established by explicitly constructing many–particle S matrices consistent with unitarity, that correspond to purely resonance–dominated dynamics. These are then used in the S–matrix formulation of statistical mechanics to obtain the grand partition function, which is seen to reveal the above result. In the following paper, operational criteria are presented for determining when in general narrow resonances and loosely bound states may be treated as "elementary" particles. (auth)

9746 EFFECTIVE ELEMENTARITY OF RESONANCES AND BOUND STATES IN STATISTICAL MECHANICS. Dashen, R.F.; Rajaraman, R. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 10: No. 2, 708-720 (15 July 1974).

Operational criteria are presented for determining those bound states and resonances which can approximately be included in the complete set of states in the S–matrix formulation of statistical mechanics. The criteria depend only on the energy dependence of S–matrix elements, as compared to the energy scales determined by the temperature and density. They are thus expressible free of nonrelativistic potential–theory language, and are hopefully valid for relativistic hadron systems as well. As an application, it is shown that the Δ resonance can be effectively treated as an elementary species under the temperature and density conditions encountered in neutron stars, while nuclei such as the deuteron can be ignored to lowest approximation. Possible conflicts with the Pauli principle, as invoked between the "constituents" of composite resonances and bound states on the one hand and free particles on the other, are resolved. (auth)

9747 DYNAMICAL CONNECTIONS BETWEEN QUARK FRAGMENTATION FUNCTIONS. Niedermayer, F. (Eotvos Lorand Tudomanyegyetem, Budapest (Hungary)). Nucl. Phys., B; 79: No. 2, 355–364(18 Sep 1974).

Assuming that the quark kicked by a virtual photon emits pions one by one, integral equations connecting the fragmentation functions $D_\mu^{\pi^+}(z)$ and $D_\mu^{\pi}(z)$ are obtained. It is shown that they have a plateau the height of which can be determined from the multiplicity difference $N_p^{\pi^+}(z) - N_p^{\pi^-}(z)$. Comparison with experiment is made. (auth)

9748 CHARGE-TRANSFER DISTRIBUTION IN NEUTRAL CLUSTER MODELS. Baier, R.; Bopp, F. W. (Bielefeld Univ. (F.R. Germany). Abt. Theoretische Physik). Nucl. Phys., B; 79: No. 2, 344–354(18 Sep 1974).

The charge transfer between hemispheres is investigated in the framework of a model with neutral and isotropic clusters. Without specifying the production mechanism of the clusters, the charge-transfer distribution can be uniquely determined by inclusive spectra. Minor discrepancies observed in the comparison with experimental data are attributed to the influence of the charges of the leading particles, and further tests are proposed. (auth)

9749 ELEMENTARY PARTICLES THEORY IN A SPACE OF SIX DIMENSIONS WITH A FIXED METRICS. Leble, S. B.; Terent'ev, I. A. Vestn. Leningrad. Univ., Fiz., Khim.; No. 2, 7–13 (May 1974). (In Russian).

Quantum mechanics in a space of six dimensions with a curvature is considered. Equations for the motion of elementary objects with an arbitrary spin were obtained. As an illustration the spectral properties of the mass operator for the particles with spin 0 and $1/2$ were investigated. (auth)

Electromagnetic

Refer also to abstracts 9521, 9931, 10165, and 10200.

9750 (DESY-74/40(Rev.)) $\Delta^{++}\pi^-$-ELECTROPRODUCTION NEAR THRESHOLD AND THE Q^2 DEPENDENCE OF THE CONTACT INTERACTION. Joos, P.; Ladage, A.; Meyer, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

The Q^2 dependence of $\sigma(\gamma_V p \rightarrow \pi^-\Delta^{++})$ was measured. Close to threshold $\sigma(\gamma_V p \rightarrow \pi^-\Delta^{++})$ is roughly proportional to $1/(m_\rho^2 + Q^2)^2$. The data are consistent with dominance of the contact term and imply that the contact term has the Q^2 dependence of the ρ propagator. (auth)

9751 (DESY-74/46) BACKWARD PRODUCTION OF π^0 BY VIRTUAL PHOTONS. Azemoon, T.; Lueke, D.; Specht, G.; Ackermann, H.; Ganssauge, E.; Janata, F.; Schmidt, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Sep 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

Electroproduction of π^0 in backward direction with respect to the virtual photon is measured in a two-arm spectrometer. Cross sections for the reaction $\gamma_V p \rightarrow \pi^0 p$ are given as functions of q^2, W and

θ^* in the regions $0.1 < |q^2| < 0.9$ GeV^2, $1.7 < W < 2.5$ GeV, $145 < \theta^* < 180°$. (auth)

9752 (DESY-74/47) RELATIONS BETWEEN THE ELECTROEXCITATION OF NUCLEON RESONANCES AND THE DEEP INELASTIC CONTINUUM FOR PROTON AND DEUTERON TARGETS. Koebberling, M.; Moritz, J.; Schmidt, K. H.; Wegener, D.; Zeller, D.; Bleckwenn, J.; Heimlich, F. H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Sep 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

New data of the electroexcitation cross section on protons and deuterons in the resonance region are compared with the results in the deep inelastic region for four-momentum transfers $q^2 \leq 1.5$ (GeV/c)^2. The Bloom-Gilman sum rule is shown to hold for $q^2 \geq 1.2$ (GeV/c)^2, while the Rittenberg-Rubinstein sum rule is saturated for $q^2 \geq 0.4$ (GeV/c)^2. It is shown that the sum rules do not saturate in a local way. (auth)

9753 (KEK-73-10, pp 75-112) SOME ASPECTS OF UNIFIED THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Kawarabayashi, K. (Tokyo Univ.). Dec 1973.

From proceedings for high energy physics; Ibaraki, Japan (17 Jul 1973).

A lecture is given on some features of the unified gauge models of weak and electromagnetic interactions emphasizing the physical motivations behind them. Included are classical theories, synthesis of weak and electromagnetic interactions, unified gauge models for leptons, and hadrons and gauge and approximate symmetries in strong interactions. (JFP)

9754 (RCN-217) UNFOLD: A FORTRAN-IV CODE FOR THE SYNTHESIS OF MOMENTUM DISTRIBUTIONS BY DECONVOLUTION OF ANGULAR CORRELATIONS OF POSITRON ANNIHILATION RADIATION OR COMPTON LINE PROFILES. Volume I. Mijnarends, P. E. (Stichting Reactor Centrum Nederland, Petten). Oct 1974. 69p. Dep. NTIS (US Sales Only) $6.50.

A Fortran-IV computer program is described which computes momentum distributions in crystalline solids by deconvolution of observed angular correlations of annihilation radiation or Compton line profiles. The program is applicable to crystals with cubic, tetragonal, or hexagonal symmetry. It can also be used for the analysis of polarized-positron experiments in magnetized materials. A summary of the underlying theory is presented. The momentum distribution is expanded in a series of orthonormal lattice harmonics of the appropriate symmetry. The coefficients in this series are functions of the radial momentum. A one-dimensional integral equation relates these coefficients to appropriately chosen linear combinations of the measured profiles. The numerical techniques employed in the program are discussed, and a description is given of each individual subprogram. A sample calculation and a listing of the program are given. (auth)

9755 APPLICATION OF GAUGE THEORIES TO WEAK AND ELECTROMAGNETIC INTERACTIONS. Zumino, B. (CERN, Geneva). pp 383-398 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

The application of gauge theories to weak and electromagnetic interactions covers the Higgs model, a Yang–Mills theory for leptons, the extension of the theory to hadrons, and renormalization and the problem of anomalies. (JFP)

9756 FORMULATION OF ABELIAN GAUGE THEORIES WITHOUT REGULATORS. Lowenstein, J. (Department of Physics, New York University, New York, New York 10003); Weinstein, M.; Zimmermann, W. Phys. Rev. D 10: No. 6, 1854-1871 (15 Sept 1974).

In this, the first of three papers, we present the essential features of a treatment of the U(1) Higgs model based upon a regulator–free, momentum–space subtraction scheme. The principal new results which follow from this approach are (1) the fields of the theory satisfy their classical equations of motion, (2) the source of the vector–meson field, $j^\mu(x)$, is a finite, conserved current, (3) the Higgs theory passes "smoothly" over to a Goldstone–boson theory when the vector–meson coupling constant (e) is set equal to zero, (4) the conserved current is gauge–invariant and can be used as an interpolating field for the stable one–particle states of the theory, and (5) one can define a generalized Higgs model wherein only part of the vector–meson comes from spontaneous breakdown; this theory has the features of the usual Higgs model, is ghost–free, but it keeps its Goldston boson. This first paper is devoted to stating precisely what can be proved and to establishing the relationship of our treatment to classical-field-theory ideas on the one hand, and other quantum-field-theoretic treatments on the other. (auth)

9757 ELECTRON–POSITRON ANNIHILATION AND HADRONIC SOURCES. Brandt, R.A. (Department of Physics, New York University, New York, New York 10003); Wing–Chiu, N. Phys. Rev. D 10: No. 6, 1918-1938 (15 Sept 1974).

The canonical leading light–cone contribution $\partial_\mu \Delta_+ (x) p_\nu f(x \cdot p) + \ldots$ to the electroproduction $[\gamma(q) + h(p) \to$ anything; γ = photon, h = hadron] matrix element $\langle h(p) | J \cdot gm(x) J_\nu(0) | h(p) \rangle$ is such that $f(\lambda)$, by virtue of the $J_\mu J_\nu$ operator–product expansion (OPE), is analytic for small λ. The corresponding contribution $\partial_\mu \Gamma_+(x) p_\nu \bar{f}$ (xhp) + hhh to the annihilation $[e^+e^- \to \gamma(q) \to h(p) +$ anything] matrix element $\langle 0 | R(J_\mu(x) \hat{S}(p)) R(J_\nu(x) \hat{S}^\dagger(-p)) | 0 \rangle$, where $\hat{S}(p)$ is the Fourier transform of a source operator S(y) for h(p), such that $\bar{f}(\lambda)$ can be singular for $\lambda \to 0$; $\bar{f}(\lambda) \sim \lambda^{-}$. We show how the multiple OPE's among the operators involved can determine the degree σ of this short–distance singularity provided long–distance effects are not important. We refer to σ as the "slant" of the matrix element and we explicitly calculate σ in terms of the minimal dimension d of the source S(y). In the canonical case, we find $\sigma = d - 1/2$ if h is a pseudoscalar particle and $\sigma = d - 1$ if h is a spinor particle. The singularities imply that the scaling functions behave like σ^σ for $\omega \equiv q^2/2q \cdot p \to \infty$ and that the multiplicities behave like $(\sqrt{q^2})^{\sigma-3}$ for $q^2 \to \infty$. These results provide handles on the heretofore elusive source dimensions d. For example, if logarithmic or greater multiplicities are observed ($\sigma \geq 3$) along with canonical scaling, it can be concluded that d cannot have its canonical elementary value ($d = 5/2$ for spinors, $d = 3$ for scalars) but rather $d \geq 7/2$ (spinors) or $d \geq 4$ (scalars). These results can be readily generalized to noncanonical cases. For example, they lead to simple explanations of known results in renormalized perturbation theory (ϕ^3 theory, ϕ^4 theory, pseudoscalar–meson theory, quantum electrodynamics). Since λ (and ω) is dimensionless, the dimensional analysis involved in our treatment is on a different footing from that which determines the usual short–distance and light–cone singularities of current products. The slants are nevertheless simple functions of the field and source dimensions. Phenomenologically, the operatorial nature of our approach makes it easily extendable to the treatment of other inclusive lepton–hadron processes with one or more particles observed in the final state. (auth)

9758 ELECTROMAGNETIC FORM FACTOR OF THE PION AND VERSIONS OF PARTIALLY CONSERVED AXIAL–VECTOR CURRENT. Nasrallah, N.F. (Faculty of Sciences, Lebanese University, Hadet–Beirut, Lebanon). Phys. Rev. D 10: No. 6, 1956-1961 (15 Sept 1974).

We relate the coupling of the divergence of the axial–vector current to the $J^P = 0^-$ nonpion continuum, $\langle 0 | \partial_\mu A^\mu | 0^-$ cont.$\rangle$, to the variation of the electromagnetic form factor of the pion between the points $t = 0$ and $t = 4m^2$ [t = (momentum transfer)^2]. We find that the validity of the assignment of a scale dimension to $D \equiv \partial_\mu A^\mu$, or simply the existence of the quantity $\int d^3y \langle 0 | [D(\vec{y},0) \vec{V}(0)] | \pi \rangle$, practically rules out the possibility $\lim_{m2 \to 0} \langle 0 | D | 0^-$ cont.$\rangle \neq 0$ (a version of "weak partially conserved axial–vector current"). (auth)

9759 TRANSITIONS TO THE GROUND STATE IN SYNCHROTRON RADIATION: NUMERICAL CALCULATIONS DERIVED FROM EXACT MATRIX ELEMENTS. White, D. (Department of Physics, Illinois Institute of Technology, Chicago, Illinois 60616). Phys. Rev. D 10: No. 6, 1726-1730 (15 Sept 1974).

The problem of an electron immersed in a uniform magnetic field is viewed from the framework of the relativistic Dirac theory. Because of the simple mathematical structure of the ground state it is possible to evaluate the first–order transition rates to the ground state λ_{n0} exactly. Explicit results for λ_{n0} are given in analytical, tabular, and graphical form for a wide range of physical conditions: electrons in "free fall" (Fairbank experiments) to pulsar emission. (auth)

9760 DEEP–INELASTIC LEPTON–HADRON SCATTERING: THE HIGGS–SCALAR CONTRIBUTION. Ma, E. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 10: No. 7, 2298-2299 (1 Oct 1974).

Assuming that electromagnetic processes are modified by the presence of a Higgs scalar particle ϕ, we discuss the possible behavior of deep–inelastic lepton–hadron scattering when the magnitude of the momentum transfer variable Q^2 is comparable to that of m_ϕ^2. (auth)

9761 RELATIVISTIC CENTER–OF–MASS VARIABLES FOR COMPOSITE SYSTEMS WITH ARBITRARY INTERNAL INTERACTIONS. Krajcik, R.A. (Physics Department, Case Western Reserve University, Cleveland, Ohio 44106); Foldy, L.L. Phys. Rev. D 10: No. 6, 1777-1795 (15 Sept 1974).

We show how a class of relativistic center–of–mass (c.m.) variables for a composite system with arbitrary interactions can be constructed to any order in $1/c^2$ by means of a nonsingular unitary transformation which arises from a study of the Lie algebra of the Pioncaré group. The class of c.m. variables so constructed subsumes the c.m. variables previously obtained my means of the singular Gartenhaus–Schwartz transformation. We explicitly determine the c.m. variables to order

$1/c^2$, and as an example consider both internal electromagnetic (EM) interactions, where simplifications are pointed out with regard to a previous study, and external EM interactions, where the complete form of the "correction" term to the Foldy–Wouthuysen EM interaction Hamiltonian is given. The results of some earlier studies of relativistic corrections to phenomenological potentials are also shown to be included in our results, and separability is briefly discussed. (auth)

9762 $p + p \to (l^+ + l^-)$ + ANYTHING IN A MODIFIED KUTI–WEISSKOPF MODEL. Pakvasa, S.; Parashar, D.; Tuan, S.F. (Department of Physics and Astronomy, University of Hawaii, Honolulu, Hawaii 96822). Phys. Rev. D 10: No. 7, 2124-2130 (1 Oct 1974).

We present here the results of calculations on $d^2\sigma/dQ^2\,dy$ and $d\sigma/dm$ for the process $p + p \to (l^+ + l^-)$ + anything using the modified Kuti–Weisskopf model quark–parton distributions. Here Q^2 is the mass squared of the dilepton system, $m = (Q^2)^{1/2}$ and $y = 2Q_L/\sqrt{s}$, with Q_L denoting the longitudinal momentum of the lepton pair in the proton–proton center–of–mass system. The calculations are performed at Brookhaven, NAL, and CERN ISR energies to illustrate the general trend. We also present the single–lepton distributions for this process at NAL and ISR energies. (auth)

9763 EXPERIMENTAL CONSEQUENCES OF QUARK STRUCTURE. West, G.B. (Institute for Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305); Zerwas, P. Phys. Rev. D 10: No. 7, 2130-2141 (1 Oct 1974).

Some experimental consequences of endowing quarks with both a finite size (form factor) and an anomalous magnetic moment are investigated within the context of the naive quark–parton model. Our discussion is limited to experiments which will be completed in the near future such as deep–inelastic electroproduction at large angles and high energies, electron–positron colliding beam experiments, high–energy neutrino and antineutrino scattering, and the production of μ pairs. The following are some definite predictions of the model which can be tested: (a) The ratio of longitudinal to transverse cross sections must begin to rise beyond $-q^2 \sim 10\ (\text{GeV}/c)^2$, reflecting a considerable scaling violation in the conventional W_1 structure function; (b) the normalized single–particle distribution functions $(1/\sigma)(d\sigma/dz)$ (z being the fractional energy carried off by the detected particle) should scale in both ep and e^+e^- processes; (c) the approach to scaling in these distributions should be much slower for smaller values of z; (d) in e^+e^-, the single–particle distribution function $s(d\sigma/dz)$ should violate scaling, especially for smaller values of z; (e) there should be only small deviations, if any, from scaling in antineutrino scattering whereas deviations in neutrino scattering should be considerable. Finally, similar experimental consequences of the presence of a second–class current in the weak interactions are explored. (auth)

9764 BREAKDOWN OF SCALING IN NEUTRINO AND ELECTRON SCATTERING. De Rújula, A.; Georgi, H.; Politzer, H.D. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 10: No. 7, 2141-2146 (1 Oct 1974).

Observation of deviations from scaling in the structure functions for deep–inelastic inclusive lepton–hadron scattering may provide a test of the hypothesis that the strong interactions are described by an asymptotically free field theory. Tests not involving additional assumptions are obtained for the combinations of structure functions $F_2(ep - en)$, $F_2(\nu - \bar{\nu})$, and $\chi F_3(\nu \text{ or } \bar{\nu})$. Neutrino and electron scattering experiments are compared as possible tests of asymptotic freedom. (auth)

9765 FLUCTUATIONS OF THE CHARGED PION NUMBER IN e^+e^- ANNIHILATION. Pais, A. (Rockefeller University, New York, New York 10021). Phys. Rev. D 10: No. 7, 2147-2153 (1 Oct 1974).

It is shown how to find bounds on $< n_{ch}^{k}(N) >$, the average of the kth power of the number of charged pions produced in the one–quantum annihilation $e^+e^- \to N\pi$. The second moment, $k = 2$, is studied in detail, also in its dependence on information on the first moment, $k = 1$. The lower bound for $k = 2$ appears to be of an experimentally significant magnitude. The $I^G = 0^-$ bounds are much tighter than those for 1^+. It is further shown that the optimal bounds can be violated if $I^G = 1^-$ and especially if $0^+ - 2^+$ interference plays a sizable role (as may happen in the two–photon process). A brief comment on $\bar{p}p$ annihilation is also made, and an asymptotic (large N) formula is given for the upper bound of the neutral–to–charged pion ratio of a neutral system, for any pure isospin. (auth)

9766 PHYSICAL EFFECTS OF HADRONIC BREMSSTRAHLUNG: REACTIONS AT LARGE AND SMALL MOMENTUM TRANSFERS. Blankenbecler, R.; Brodsky, S.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Gunion, J.F.; Savit, R. Phys. Rev. D 10: No. 7, 2153-2164 (1 Oct 1974).

The synthesis of Regge behavior and other hadronic features with the parton model is discussed. Regge behavior of electromagnetic and weak amplitudes is shown to be a consequence of hadronic bremsstrahlung and the Regge behavior of hadronic amplitudes. A characterization of the hadronic wave function in terms of two components is emphasized. One component, which arises from the constituents of the hadronic bremsstrahlung, yields the wee–parton spectrum and Regge behavior and falls rapidly as any one constituent is constrained to take most of the momentum of the incident hadron. The second component, which is hadron irreducible, and most probably involves the minimum number of parton constituents, must have approximately power–law falloff in invariant variables. Only this second component contributes to large–angle exclusive scattering, the form factors at large t, and the scaling structure function for x near 1. This component is responsible for the Drell–Yan–West relation and yields simple crossing to the annihilation channel at $x \sim 1$. Our approach and analysis clarify the nature of the impulse approximation in hadronic scattering. For example, the dramatic fixed–pole nature of the Compton amplitude at large t is discussed and its importance is emphasized. (auth)

9767 UNITARY MULTICHANNEL SIDEWISE DISPERSION CALCULATION OF THE NUCLEON ANOMALOUS MAGNETIC MOMENTS. Lee, P.S.; Shaw, G.L.; Silverman, D. (Physics Department, University of California, Irvine, Irvine, California 92664). Phys. Rev. D 10: No. 7, 2251-2254 (1 Oct 1974).

In sidewise dispersion calculations of the anomalous magnetic moments of the nucleon, the intermediate πN strong states involved are the S_{11} and P_{11}, both of which are highly inelastic at low energies. These inelastic effects have not previously been included in a systematic manner consistent with unitarity in order to ensure a real absorptive part. We present a multichannel ND^{-1} formalism for the strong scattering and photoproduction which gives a unitary result for the anomalous moments. The strong form factor is given simply in terms of D^{-1}. Explicit calculations demonstrate that contributions to the dispersion integrals far beyond $W \sim 1500$ MeV will be necessary in determining μ. (auth)

9768 DIRAC-LIKE EQUATION FOR THE PHOTON ACCORDING TO ETTORE MAJORANA. Mignani, R. (Univ., Rome); Recami, E.; Baldo, M. Lett. Nuovo Cim.; 11: No. 12, 568-572 (23 Nov 1974).

A Dirac-like equation is written for the photon. The importance in electrodynamics of the complex quantity $F = E - iH$, which is an essential tool in the present attempt, is stressed. (JFP)

9769 LEPTONS WITH HADRONIC CORE. Chanda, R. (Federal Univ., Rio de Janeiro). Lett. Nuovo Cim.; 11: No. 13, 593-595(30 Nov 1974).

The data on e^+e^- annihilation into hadrons are interpreted by invoking in addition to the usual one-photon exchange mechanism, a direct nonelectromagnetic lepton–hadron interaction which comes into play only at high energies at short distances. (JFP)

9770 TWO-COMPONENT MODEL FOR e^+e^- HADRONIC ANNIHILATION. Schlereth, H. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 11: No. 13, 581-586(30 Nov 1974).

It was previously found that the present data on the well known ratio $R(q^2){:} = \alpha\ (e^+e^- \to \text{hadrons}\ e^-e^+ \to \mu^-\mu^+)$ can be fitted by the formula $R(q^2) = 2 + c_0\,q^2$ with $q^2 > 0$ in $(\text{GeV}/c)^2$ and $c_0 \simeq 1/7$ a constant with dimension $(\text{mass})^{-2}$. The expected typical phase space structure is discussed in detail. First a general conjecture on the scaling respectively nonscaling behavior of the n-particle inclusive distributions is derived using the energy–momentum conservation constraints. For simplicity identical particles in the inclusive process e^+e^- are considered. (JFP)

9771 SEMI-EMPIRICAL DETECTION OF THE DIRAC'S MAGNETIC MONOPOLES. Sawada, T. (Tokyo Univ. of Education (Japan). Dept. of Physics). Phys. Lett., B; 52: No. 1, 67-70 (16 Sep 1974).

In order to examine whether the Dirac's magnetic monopoles exist within the hadrons as their constituents, the nucleon–nucleon phase-shift data of MacGregor et al. is analyzed in search of the strong van der Waals type force. By making a peripheral combination of the partial wave amplitudes and separating the one and two pion exchange contribution it is observed that the residual force is exerting between the nucleons, which should be attributed to the exchange of a hypothetical scalar meson or to the long range force. The mass of such a scalar meson must be $m_s = 1.1\,\mu_\pi$, on the other hand the power β of the long range potential, which is defined by $V^{\text{extra}}(r) = -C/r^{\beta}$ for larger r, becomes $\beta = 7.2 \pm 1.0$, and this value is consistent with the van der Waals potential of the Casimir–Polder type. (auth)

9772 THE MESON ELECTROMAGNETIC DECAYS FROM $SU(4)_W$ AND GENERALIZED VECTOR DOMINANCE. Gounaris, G. J. (Ioannina Univ. (Greece). Dept. of Physics). Phys. Lett., B; 51: No. 5, 491-495(2 Sep 1974).

By using $SU(4)_W$ and generalized vector dominance (GVD), the electromagnetic meson decays are expressed in terms of the pion form factor. Ordinary VMD seems adequate for one-photon processes. Data indicate that U(3) is better in the constituent than in the current quark frame. (auth)

9773 ISOSPIN BOUNDS AND BOSE CONDENSATION IN e^+e^- ANNIHILATION. Devenish, R. C. E.; Koller, K.; Walsh, T. F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Schiller, D. H. (Hamburg Univ. (F. R. Germany). 2. Inst. fuer Theoretische Physik). Phys. Lett., B; 52: No. 1, 97-101(16 Sep 1974).

The isospin bounds are derived for two particle correlations in $e^+e^- \to \gamma \to N\pi$, and the physical significance of saturation of the upper bound is discussed and various multiplicity distributions for this case are presented. (auth)

9774 A FIXED POLE SUM RULE IN PHOTON—PHOTON SCATTERING. Worden, R. P. (Science Research Council, Chilton (UK). Rutherford Lab.). Phys. Lett., B; 52: No. 1, 87-90(16 Sep 1974).

There is a J = 0 right-signature fixed pole in the amplitude $T_{++--}(\gamma 1\gamma 2 \to \gamma 1\gamma 2)$ for forward elastic photon—photon scattering. When one of the photons is real ($q_1^2 = 0$), the pole residue is an integral of a measurable photon—photon total cross section. It is shown in the parton model that the residue is $(-1/2\pi^2)\Sigma e_1^4$, independent of the other photon's mass-squared q_2^2, and so measures the sum of fourth powers of parton charges. Since no leading Regge poles enter in the sum rule, it can be evaluated more easily than $\gamma p \to \gamma p$ fixed pole sum rules. (auth)

9775 HADRONIC ASPECTS OF PHOTON—NUCLEUS INTERACTIONS. Weise, W. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Phys. Rep.; 13: No. 2, 53-92(Sep 1974).

The more recent developments in understanding the interaction of high energy photons (i.e., photons with an energy of several GeV) with nuclei are reviewed. The treatment is based on the relation between the photon scattering amplitude and the hadronic part of the Lehmann spectral density of the photon propagator. General aspects are emphasized rather than calculation details. Global consistency requirements between low and high energy data are discussed in terms of a photonuclear sum rule based on dispersion relations. In addition, some possible asymptotic extrapolations of photon cross sections are investigated. (auth)

9776 e^+e^- ANNIHILATION INTO HADRONS AND THE NATURE OF THE HADRONIC FIXPOINT. Nachtmann, O. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). Phys. Lett., B; 51: No. 5, 469-471(2 Sep 1974).

It is shown that the experimental behavior of the ratio $R = \sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-)$ has a natural explanation if hadron interactions at short distances are described by an infrared stable fixpoint of the renormalization group. Experimental estimates of the limiting value of R, the 90% saturation point and the anomalous dimension d_θ of the trace of the energy momentum tensor are given. (auth)

9777 ASYMPTOTIC BEHAVIOR OF FORM FACTORS FOR TWO— AND THREE—BODY BOUND STATES. Alabiso, C.; Schierholz, G. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 3, 960-967 (1 Aug 1974).

The asymptotic power behavior of the electromagnetic form factors is examined for two— and three—body s—wave bound states, both relativistic and nonrelativistic. In the nonrelativistic case, we consider local and separable two—body potentials and we make use of the Faddeev equations in order to define the three—body bound states. For local potentials which behave as $(|\vec{k}|)^{-1-\theta}$ $(0 < \theta)$ for large momentum transfer, we obtain for the asymptotic power behavior of the form factors of the two— and three—body bound states $F_2(\vec{q}) \simeq (|\vec{q}|)^{-3-\theta}$ and $F_3(\vec{q}^2) \simeq (|\vec{q}|)^{-6-2\theta}$, respectively. For separable potentials $V = g(|\vec{k}|)g(|\vec{k}'|)$ and $g(|\vec{k}|) \simeq (|\vec{k}|)^{-1/2-\theta}$ we find $F_2(\vec{q}^2) \simeq (|\vec{q}|)^{-2-2\theta}$ $(0 < \theta \leqslant 1/2)$, $F_2(\vec{q}^2) \simeq (|\vec{q}|)^{-2.5-\theta}$ $(1/2 \leqslant \theta)$, and $F_3(\vec{q}^2) \simeq (|\vec{q}|)^{-5-2\theta}$, respectively. For the relativistic case, we consider the two— and three—body Bethe—Salpeter equation in the ladder approximation. We treat the spin—zero case only but we believe that our final conclusions will be affected by the introduction of spin—1/2 particles. With an interaction which behaves as $(k^2)^{-\theta}$ $(0 < \theta)$ at large momentum transfer, we obtain $F_2(q^2) \simeq (q^2)^{-1-\theta}$ and $F_3(q^2) \simeq (q^2)^{-2-2\theta}$ (auth)

9778 CONDITIONS FOR AN $SU_L(3) \otimes U(1)$ GAUGE THEORY. Clavelli, L.; Yang, T.C. (Center for Theoretical Physics, and Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 10: No. 2, 658-662 (15 July 1974).

We study the possibility of constructing an $SU_L(3) \otimes U(1)$ gauge theory of weak and electromagnetic interactions consistent with experiment and allowing room for the incorporation of renormalizable strong interactions. Greater than usual attention is paid to the stability of the Higgs potential and serious difficulties are encountered. We argue that a satisfactory $SU(3)_L \otimes U(1)$ model based on elementary Higgs fields requires a global or discrete symmetry beyond SU(3) in the Higgs sector. (auth)

9779 MODEL—INDEPENDENT LOWER BOUNDS FOR MASSLESS—PARTICLE SCATTERING. Healy, J.B. (The Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 10: No. 2, 644-652 (15 July 1974).

We examine massless pion—pion, neutrino—neutrino, and light—by—light scattering within the context of a dispersion approach to the interaction of massless particles. We assume the existence of a fixed—t dispersion relation with a finite number of subtractions for $t \leqslant 0$, unitarity, crossing symmetry, and the convergence of helicity expansions in the physical region. All three processes have a zero at threshold in the forward amplitude; for massless pions it is the Adler zero and for neutrinos and photons it is a kinematic zero. We demonstrate that the forward scattering amplitudes and total cross sections have the asymptotic lower bounds $|F(s, 0)| \geq \text{const}$ and $\sigma_{\text{tot}}(s) \geq \text{const}/s^2$. We obtain the same result for scattering of neutrinos on electrons. We also generalize the upper bounds obtained by Dolgov, Zakharov, and Okun for lepton—lepton scattering to massless $\pi-\pi$ and light—by—light scattering. (auth)

9780 ELECTRON—ELECTRON SCATTERING: SPECTRAL FORMS FOR THE INVARIANT AMPLITUDES TO ORDER e^4. DeRaad, L.L. Jr. (Department of Physics, University of California, Los Angeles, California 90024); Ng, Y.J. Phys. Rev. D 10: No. 2, 683-693 (15 July 1974).

The five invariant amplitudes for electron—electron scattering to order e^4 are calculated using the causal methods of source theory. The basis set employed, which is free of kinematic singularities and zeros, consists of the Fermi invariants. The amplitudes are expressed in terms of double—spectral forms with accompanying single—spectral forms which are determined by analysis of causal forward scattering. The radiative corrections required for the analysis of polarization experiments are contained in these amplitudes. (auth)

9781 DISPERSION CALCULATION OF THE TRANSITION FORM FACTOR $F_{\pi\omega\gamma}(t)$ WITH CUT CONTRIBUTIONS. Köpp, G. (III. Physikalisches Institut, Technische Hochschule Aachen, Aachen, West Germany). Phys. Rev. D 10: No. 3, 932-940 (1 Aug 1974).

In this paper we study the t dependence of the $\gamma\pi\omega$ vertex functions on the basis of partial—wave dispersion relations and unitarity. The right—hand cut is approximated by the 2π contribution and the left—hand cut by the nearest s— and u—channel poles. The electromagnetic $\pi\omega$ transition form factor is calculated as a function of t in the timelike and spacelike region and is compared with predictions of the ρ—dominance model and with recent experimental data for $e^+e^- \to \omega\pi^0 \to \pi^+\pi^-\pi^0\pi^0$ near threshold. The influence of the left—hand cut and the finite width of the ρ resonance is explicitly shown. (auth)

9782 SCALAR CONTRIBUTION TO THE e^+e^- ANNIHILATION IN ASYMPTOTICALLY FREE THEORIES. Kang, J.S. (Brandeis University, Department of Physics, Waltham, Massachusetts 02154). Phys. Rev. D 10: No. 3, 1047-1050 (1 Aug 1974).

The neutral scalar mesons are incorporated into the asymptotically free theories to see if it can explain the experimental approach of the e^+e^- total cross section to its possible scaling limit. The corresponding fourth—order vacuum polarizations are calculated. The scalar contributions are found to be unable to explain the experiments as the limiting behavior in the semiasymptotic region. (auth)

9783 MAGNETIC MONOPOLES IN UNIFIED GAUGE THEORIES. Hooft, G. 't. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 79: No. 2, 276-284(18 Sep 1974).

It is shown that in all those gauge theories in which the electromagnetic group U(1) is taken to be a subgroup of a larger group with a compact covering group, like SU(2) or SU(3), genuine magnetic monopoles can be created as regular solutions of the field equations. Their mass is calculable and of order 137 M_W, where M_W is a typical vector boson mass. (auth)

9784 EXCHANGE DEGENERACY IN $K^+\Lambda$ OR Σ^0 PHOTOPRODUCTION. Goldstein, G. R. (Tufts Univ., Medford, Mass. (USA). Dept. of Physics). Nucl. Phys., B; 79: No. 2, 341-343(18 Sep 1974).

The contributions of the K^* and K^{**} exchange degenerate trajectories to $K^+\Lambda$ and $K^+\Sigma^0$ photoproduction are related by SU(3), VDM and duality. It is shown that the correct relation gives a ratio of 3 to 1 for the residues of K^{**} to K^*, respectively. This result contradicts the often assumed equality of the residues. (auth)

9785 ELECTRON-FIELD BREMSSTRAHLUNG AT INTERMEDIATE ELECTRON ENERGIES. Altman, J. C.; Quarles, C. A.

(Texas Christian Univ., Fort Worth (USA)). Phys. Lett., A; 49: No. 4, 311-312(23 Sep 1974).

Hodes' formula for the differential cross section for electron-field bremsstrahlung was numerically evaluated and integrated over the direction of the scattered electron. The results are in good agreement with the measurements of Nakel and Pankau and of Rester. (auth)

9786 SPIN CORRELATION MEASUREMENTS IN PSEUDOSCALAR MESON PHOTOPRODUCTION. Goldstein, G. R.; Owens, J. F. III; Rutherfoord, J. P. (Tufts Univ., Medford, Mass. (USA). Dept. of Physics); Moravcsik, M. J. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Nucl. Phys., B; 80: No. 1, 164-188 (4 Oct 1974).

Because polarized photon beams and polarized proton targets have improved considerably and the techniques for measuring recoil baryon polarizations are continually improving, it is becoming feasible to measure double and triple spin correlations in pseudoscalar meson photoproduction. Of the large number of such experiments possible, only a few will add significantly new information to that already obtained from the existing cross section and limited polarization measurements. By using a simple, general, and transparent method, it is shown that all such measurements fall into three classes: (a) those which are equivalent to more simple measurements, (b) those which are highly bounded by previous measurements, and (c) those which yield truly new information. (auth)

9787 ON THE PRESENCE OF NON-ADDITIVE CONTRIBUTIONS TO CONSTITUENT QUARK CALCULATIONS OF RESONANCE PHOTOPRODUCTION. Osborn, H. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 80: No. 1, 113-126 (4 Oct 1974).

It is shown by considering generalized Cabibbo–Radicati and Drell–Hearn–Gerasimov sum rules for all states in the 56, L = 0, baryon multiplet that it is essential for the current exciting the various higher resonance multiplets to contain nonadditive or non-35 contributions. This is in addition to the full structure for currents belonging to a 35 allowed by the Melosh transformation between current and constituent quarks; the only exceptions would be if the proton and neutron anomalous magnetic moments were in the ratio $\kappa_p/\kappa_n = -\frac{3}{2}$, instead of ~ -1. The extra terms are also suggested by the requirement of maintaining pure M1, with E2 forbidden, photo-excitation of the Δ. Further, a non-zero electric quadrupole moment for states in the decuplet is also derived. These results are all necessitated by paying careful attention to relativistic angular constraints. (auth)

9788 RESONANCES AND SCALING IN THE NON-FORWARD COMPTON AMPLITUDE. Jersak, J. (Institut fuer Theoretische Physik, RWTH, Schinkelstr. 2/IV, 51 Aachen, FR Germany). Nucl. Phys., B; 80: No. 2, 322-340(11 Oct 1974).

By assuming that the scaling law interpolates the non-forward Compton amplitude in the resonance region, the threshold behavior of the non-forward scaling function is determined from the threshold behavior of the electroproduction scaling function. In addition, the threshold behavior of the deep inelastic annihilation scaling function is determined and found to be equal to that of the electroproduction scaling function. A Veneziano-like pole model for the non-forward Compton amplitude with these properties is constructed. In this model the scaling law interpolates the annihilation amplitude in the resonance region, too. (auth)

9789 DUAL MODELS FOR NON-HADRONS. Scherk, J.; Schwarz, J. H. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 81: No. 1, 118-144(25 Oct 1974).

The possibility of describing particles other than hadrons (leptons, photons, gauge bosons, gravitons, etc.) by a dual model is explored. The Virasoro–Shapiro model is studied first, interpreting the massless spin-two state of the model as a graviton. It is proved that in the limit of zero slope (with $g^2_{vs}\alpha'$ held fixed) one obtains the Einstein theory of gravitation accompanied by a massless scalar field. Next, the Veneziano model is studied for small slope as an expansion in powers of α'. It is known from previous work that the zeroth order term is precisely the Yang-Mills theory of a multiplet of massless vector bosons. It is shown that there are order α' terms arising both from the dual tree and loop graphs. The former constitutes a relatively unimportant modification of the Yang-Mills theory, whereas the latter involves the coupling of the massless scalar and graviton states of the Virasoro-Shapiro model. Thus one may take the point of view that gravity arises as a unitarization effect in a dual unified theory of electromagnetism and weak interactions. In order to obtain the correct values for the electric charge and Newton's constant it is necessary that $\alpha' \sim 10^{-34}$ GeV^{-2}. The coupling of massless scalar states is also studied. (auth)

9790 ISOSPIN BOUNDS FOR ENERGY PARTITION IN $\bar{e}e$ AND $\bar{N}N$ ANNIHILATION. Bell, J. S.; Karl, G.; Llewellyn Smith, C. H. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 52: No. 3, 363-366(14 Oct 1974).

In reactions such as $\bar{e}e \rightarrow$ anything, $\bar{N}N \rightarrow$ anything, the final state (neglecting secondary isospin-violating decays) is customarily supposed to have isospin zero or one. It is shown that for such states the average fraction (X) of the energy carried away by neutral pions is bounded by $X < (9 + \sqrt{41})/20 \sim 0.77$, when $I_3 = 0$ (e.g., for ee, pp, nn) and by $X > (11 - \sqrt{41})/40 \sim 0.115$, when $I_3 = \pm 1$ (e.g., for pn or np). (auth)

9791 LIGHT CONE STRUCTURE OF THE CURRENT TWO-POINT FUNCTION AND ASYMPTOTIC BEHAVIOUR IN MOMENTUM SPACE. Magg, M. (Technische Hochschule Aachen (F. R. Germany)). Phys. Lett., B; 52: No. 3, 360-362(14 Oct 1974).

The correspondence is proved between the degree of singularity of a two-point function on the light cone and the asymptotic behavior of its Fourier transform. The result is relevant for e^+-e^- annihilation. (auth)

Weak

Refer also to abstract 9384.

9792 (COO-2271-30) SIGNATURES OF NEUTRAL CURRENTS AND HEAVY LEPTONS IN WEAK INELASTIC PROCESSES. Soni, A. (Columbia Univ., New York (USA). Dept. of Physics). 1974. 17p. Dep. NTIS $4.00.

With the aim of differentiating "muonless" reactions which proceed via neutral currents from those via an intermediate heavy lepton, various spectra of the hadronic continuum from the two processes are analyzed. Similarly, the spectra of the leptonic decay modes are examined. The width of the heavy lepton is evaluated using $R(s) = (e^+e^- \rightarrow \text{hadrons}/e^+e^- \rightarrow \mu^+\mu^-) = as + b$ and a and b are related to the cross section for vanishing transverse momentum of the hadronic continuum. (auth)

9793 (COO-3072-31) TESTS OF COUPLING TYPES IN WEAK MUONLESS REACTIONS. Kingsley, R. L.; Shrock, R.; Treiman, S. B.; Wilczek, F. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). 1974. Contract AT(11-1)-3072. 16p. Dep. NTIS $4.00.

Various experimental tests are discussed that might serve to reveal the space–time structure of the interactions responsible for weak processes of the type $\nu(\bar{\nu})$ + hadron $\rightarrow \nu(\bar{\nu})$ + hadrons. (auth)

9794 (COO-3072-32) SCALING DEVIATIONS FOR NEUTRINO REACTIONS IN ASYMPTOTICALLY FREE FIELD THEORIES. Zee, A.; Wilczek, F.; Treiman, S. B. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). 1974. Contract AT(11-1)-3072. 42p. Dep. NTIS $5.25.

Several aspects of deep inelastic neutrino scattering are discussed in the framework of asymptotically free field theories. The growth behavior of the total cross sections at large energies is considered. Because of the deviations from strict scaling which are characteristic of such theories the growth need not be linear. However, upper and lower bounds are established which rather closely bracket a linear growth. Next the expected pattern of scaling deviation for the structure functions and, correspondingly, for the differential cross sections, is considered in more detail. The analysis is based on certain speculative assumptions. The focus is on qualitative effects of scaling breakdown as they may show up in the x and y distributions. The last section deals with deviations from the Callan–Gross relation. (auth)

9795 (JINR-E2-8196) LEPTON SCATTERING OFF POLARIZED PROTON TARGET AND NEUTRAL CURRENTS. Bilen'kii, S. M.; Dadayan, N. A.; Khristova, E. Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

The P-violating asymmetry of the scattering unpolarized leptons and antileptons off polarized proton target in the Weinberg model is calculated. The elastic and deep inelastic lepton-proton scattering are discussed in detail. The asymmetries in the different kinematical intervals are examined for different values of the Weinberg parameter $\sin^2 \theta_W$. (auth)

9796 KAON NONLEPTONIC DECAYS AND CHIRAL–SYMMETRY BREAKING. McNamee, P.C. (Departamento de Física, Pontificia Universidade Católica, Rio de Janeiro, Brazil); Scadron, M.D. Phys. Rev. D 10: No. 7, 2280-2297 (1 Oct 1974).

A consistent formulation of current algebra and pion partial conservation at axial–vector current is given for the kaon nonleptonic weak decays $K \rightarrow 2\pi$ and $K \rightarrow 3\pi$. This includes evaluation of kaon σ terms and $\Delta I = 1/2$ and $\Delta I = 3/2$ contributions to the weak current—current Hamiltonian. A large meson σ term, $\sigma_{KK} \sim 2m_\pi^2$, apparently is necessary to explain the $K_{2\pi}$ and $K_{3\pi}$ measured decay parameters. The hyperon nonleptonic decays are then reexamined and also shown to be compatible with a large value for σ_{KK}. Implications for the $(3,\bar{3})$ chiral—symmetry—breaking model and for octet dominance of the weak Hamiltonian are then discussed. (auth)

9797 FINITE UNITARY THEORY OF PURE LEPTONIC WEAK INTERACTION. Chiang, C.; Wang, K. (Center for Particle Theory, Physics Department, University of Texas, Austin, Texas 78712). Phys. Rev. D 10: No. 7, 2211-2216 (1 Oct 1974).

Based on the V—A interaction, a finite, unitary theory of pure leptonic weak interaction is formulated in the framework of the finite quantum field theory with shadow states. A perturbative series, originated from the conventional expansion, is obtained. This new perturbative series converges in the high—energy region where the original one does not. The difference between the prediction of this theory and the universal V—A theory is negligible in low—energy regions but becomes significant in high—energy regions. (auth)

9798 NEUTRAL WEAK CURRENTS AND A LIGHT SCALAR MESON. Barshay, S. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 10: No. 7, 2313-2315 (1 Oct 1974).

It has been noted that present discrepancies between the QED theoretical predictions and the experimental values of certain muonic x—ray transitions can be explained if a very light scalar meson exists with a product of coupling constants to muons and to nucleons of greater than about 2×10^{-7}. If such a meson couples to the muon neutrino, elastic scattering can occur with $\sigma(\nu_\mu(\bar{\nu}_\mu) + N \to \nu_\mu(\bar{\nu}_\mu) + N)/\sigma(\nu_\mu + n \to \mu^- + p) \gtrsim 17\%$ for neutrinos of about 1 GeV laboratory energy. (auth)

9799 NONLEPTONIC DECAYS OF HYPERONS. Kaushal, V.; Khanna, M.P. (Department of Physics, Panjab University, Chandigarh—160014, India). Phys. Rev. D 10: No. 7, 2165-2168 (1 Oct 1974).

Nonleptonic decays of hyperons have been investigated using current algebra and the hypothesis of partially conserved axial—vector current. With the help of two empirical rules, the contribution of certain pole terms to parity—conserving decays is suppressed. This leads to a simultaneous good fit for both the parity—violating and parity—conserving decay amplitudes while preserving the possibility of the universal parity—conserving spurion. (auth)

9800 IMPLICATIONS OF SECOND—CLASS CURRENTS FOR NEUTRAL WEAK CURRENTS AND GAUGE MODELS. Kim, B.R.; Rodenberg, R. (III. Physikalisches Institut, Technische Hochschule Aachen, Aachen, West Germany). Phys. Rev. D 10: No. 7, 2234-2236 (1 Oct 1974).

Exploiting the Hermiticity of hadronic neutral weak currents, we investigate implications of second—class charged currents for hadronic neutral weak currents. The main result is that if second—class charged currents exist, the isospin $I = 1$ axial—vector neutral current must be a "new" current, or it must contain a "new" $I = 1$ piece. Another result is that if the $I = 1$ axial—vector neutral current is "old" (that is, it is proportional to the third component of the charged current), then the proportionality constant is real. In this case second—class charged currents are excluded. CP invariance is assumed throughout the discussion. (auth)

9801 IMPLICATIONS OF ANOMALOUS LORENTZ STRUCTURE IN NEUTRAL WEAK PROCESSES. Kingsley, R.L.; Wilczek, F.; Zee, A. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 10: No. 7, 2216-2218 (1 Oct 1974).

Effects of possible anomalous Lorentz structures in the neutral weak interaction in neutrino—electron scattering, deep—inelastic neutrino—nucleon scattering, and pion production in the N^* region are discussed. (auth)

9802 ESTIMATE OF THE CHARMED VECTOR—MESON MASSES FROM $K_S \to 2\pi$ DECAYS. Yang, T.C. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 10: No. 7, 2219-2225 (1 Oct 1974).

Gauge models with charmed quarks have extra charmed—current contributions to the nonleptonic decays. Extending previous analysis of $K_S \to 2\pi$ decays to include charmed—current contributions, we find it likely that the mass of the charmed vector mesons is ~5 GeV in the $SU_L(2) \otimes U(1)$ gauge model of quartet quarks. It is remarkable that within this framework the $\Delta I = 1/2$ rule may correspond to the possibly dominant role of the charmed currents. The method of calculation makes use of (1) the Glashow—Schnitzer—Weinberg (soft—pion, soft—kaon) calculation of $K_S \to 2\pi$, but in the presence of charm, and (2) the Weinberg spectral sum rules, assumed valid for SU(3) and assumed to be saturated by the lowest—lying uncharmed and charmed vector and axial—vector mesons. (auth)

9803 LEAKAGE OF QUARK CHARGE. Farrar, G.R. (Lauritsen Laboratory of Physics, California Institute of Technology, Pasadena, California 91109); Rosner, J.L. Phys. Rev. D 10: No. 7, 2226-2229 (1 Oct 1974).

A sequential model for the fragmentation of a quark into hadrons is constructed with the property that a net charge Q "leaks" down the multiperipheral chain. Specifically, for a process initially producing a quark, $Q = 1/3\ (1 - r)/(2 + r)$, where r is the ratio of directly produced $K^\pm$ to $\pi^\pm$ in the quark fragmentation plateau. This expression corrects an earlier one in which the consequences of such a model were misstated. (auth)

9804 SOME RARE DECAY MODES OF THE K MESON IN A CURRENT—CURRENT QUARK MODEL. I. $K \to \pi l^+ l^-$ DECAY. Rockmore, R.; Kamal, A.N. (Theoretical Physics Institute, Department of Physics, University of Alberta, Edmonton, Alberta Canada). Phys. Rev. D 10: No. 7, 2091-2094 (1 Oct 1974).

$K^+ \to \pi^+ l^+ l^-$ decay is calculated in a zero—parameter modified baryon—loop model which has proven successful in describing the weak radiative kaon decays. The weak Hamiltonian is phenomenologically constructed from one—baryon octet matrix elements. The predicted branching ratio of the loop model $r_+(e^+e^-) = \Gamma(K^+ \to \pi^+ e^+ e^-)/\Gamma(K^+ \to \text{all}) = 1.6 \times 10^{-6}$ [with $r_+(\mu^+\mu^-) = 0.3 \times 10^{-6}$] compares reasonably with the prediction of a recent gauge—theory calculation of Lee and Gaillard, $r_+^{G.T.}(e^+e^-) \sim 10^{-6}$ (with acceptable values ranging between 3×10^{-6} and 0.5×10^{-6}) and is to be compared with the presently available experimental upper bound $r_+^{exp}(e^+e^-) < 0.4 \times 10^{-6}$. We also find the ratio $\Gamma(K_S^0 \to \pi^0 e^+ e^-)/\Gamma(K^+ \to \pi^+ e^+ e^-)$ to be essentially zero in the loop model, as opposed to its value of unity in the gauge—model calculation. (auth)

9805 DETECTION OF NEUTRAL WEAK CURRENTS. Cline, D. B.; Mann, A. K.; Rubbia, C. Sci. Amer.; 231: No. 6, 108-109; 112-119(Dec 1974).

A series of experiments is described in which a beam of high energy neutrinos is used to produce a higherto unobserved class of weak interactions characterized as neutral-weak-current interactions. The results of these experiments obtained over the past year give important evidence suggesting that the weak force is connected to an underlying level not only with the electromagnetic force but also possibly with the strong force. (JFP)

9806 AN ESTIMATE OF HIGHER ORDER CONTRIBUTIONS TO ELASTIC NEUTRINO-NUCLEON SCATTERING AT CERN-GARGAMELLE ENERGY. Kim, B. R. (Technische Hochschule Aachen (F.R. Germany). 3. Physikalisches Inst.). Phys. Lett., B; 52: No. 1, 65-66(16 Sep 1974).

Using information on neutrino nucleon total cross section together with the optical theorem an estimate is given of higher order contributions for elastic neutrino nucleon scattering at the Gargamelle energy. At the incident neutrino energy of 10 GeV the higher order contributions are for neutrino proton scattering a factor 10^{-7} smaller than the first order contribution (10^{-9} for neutrino neutron scattering). (auth)

9807 THE PHASE $\phi_\pm$ OF CP VIOLATION IN THE $K^0 \to \pi^+\pi^-$ DECAY. Gjesdal, S.; Presser, G.; Steffen, P.; Steinberger, J.; Vannucci, F.; Wahl, H. (European Organization for Nuclear Research, Geneva (Switzerland)); Eisele, F.; Filthuth, H.; Lueth, V.; Zech, G. (Heidelberg Univ. (F.R. Germany). Inst. fuer Hochenergiephysik). Phys. Lett., B; 52: No. 1, 119-121(16 Sep 1974).

The phase $\phi_\pm$ is evaluated on the basis of measurements of the K_S-K_L interference in the $\pi^+\pi^-$ decay mode and the mass difference Δm, both reported previously by this group. The result is $\phi_\pm = 45.9^0 \pm 1.6^0$. This, together with previous results on $|\eta_\pm|$, $|\eta_{00}/\eta_\pm|$ and the charge asymmetry β in leptonic decay, is compared with the prediction of the superweak model, with good agreement. Finally the result is used to find, on the basis of unitarity, a new upper limit on CP violation in the decay $K^0 \to 3\pi^0$. This limit is $|\eta_{000}|^2 \lesssim 0.21$. (auth)

9808 THE ABSENCE OF FINAL STATE INTERACTION CORRECTIONS TO THE DRELL—YAN FORMULA FOR MASSIVE LEPTON PAIR PRODUCTION. Cardy, J. L.; Winbow, G. A. (Science Research Council, Daresbury (UK). Daresbury Lab.). Phys. Lett., B; 52: No. 1, 95-96(16 Sep 1974).

It is shown that when final state interactions are added to the parton model Drell—Yan formula for massive lepton pair production, they do not change the cross section. (auth)

9809 FINAL STATE INTERACTIONS IN THE PARTON MODEL AND MASSIVE LEPTON PAIR PRODUCTION. Henyey, F. (Michigan Univ., Ann Arbor (USA)); Savit, R. (National Accelerator Lab., Batavia, Ill. (USA)). Phys. Lett., B; 52: No. 1, 71-73(16 Sep 1974).

It is shown that when final state interactions are added to the parton model (Drell—Yan) formula for massive lepton pair production, the cross section decreases. The proof rests on assumptions similar to those made by Landshoff and Polkinghorne and others. Thus, contrary to previous claims, this effect cannot help explain the discrepancy between the parton model predictions for this process and the BNL data. (auth)

9810 WHEN DO QUARK–ANTIQUARK PAIRS BECOME RELEVANT IN LEPTON–HADRON SCATTERING? Kim, B. R.; Rodenberg, R. (Technische Hochschule Aachen (F.R. Germany). 3. Physikalisches Inst.). Phys. Lett., B; 51: No. 5, 483-486 (2 Sep 1974).

By assuming Regge behavior at small x together with the generalized vector dominance model, an estimate of the contribution of quark–antiquark pairs (core quarks) in deep inelastic lepton–hadron scattering processes is given. At $x = 0.02$ the core quark contribution is about 50%, and 75% for $x = 0.002$. (auth)

9811 DEEP INELASTIC LEPTON–NUCLEON SCATTERING WITHOUT POINT-LIKE CONSTITUENTS. Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Phys. Lett., B; 51: No. 5, 465-468(2 Sep 1974).

Neutrino– and antineutrino–nucleon scattering into hadrons is analyzed and related to electron–nucleon scattering according to a scaling model which has been recently proposed. The electromagnetic and weak structure functions are determined and explicitly given in terms of the πN total cross sections. Predictions are made in good agreement with experiments. (auth)

9812 VECTOR-MESON DOMINANCE IN THE HADRONIC AND RADIATIVE WEAK NON-LEPTONIC DECAYS OF HYPERONS. Gavroglu, K.; Gottlieb, H. P. W. (Imperial Coll. of Science and Technology, London (UK)). Nucl. Phys., B; 79: No. 1, 168-188 (11 Sep 1974).

The radiative pionic hyperon decays $B \to B'\pi\gamma$ are investigated in the framework of vector-meson dominance. K^*, ρ and photon poles are used in association with various models for vertices to obtain alternative descriptions to the usual bremsstrahlung and current algebra approaches. A phenomenological model for the $B \to B'\gamma$ decays is included in the same spirit. (auth)

9813 QUASIELASTIC NEUTRINO–DEUTERON SCATTERING. Singh, S.K. (Department of Physics, Indian Institute of Technology, Kanpur (U.P.), India). Phys. Rev. D 10: No. 3, 988-992 (1 Aug 1974).

The differential cross section $d\sigma/dq^2$ for the process $\nu + d \to \mu^- + p + p$ is calculated in impulse approximation, using closure over the final dinucleon states. Numerical results are presented which are suitable for determining $F_A(q^2)$ from experiments. A comparison is made with earlier and similar related work. (auth)

9814 RARE DECAY MODES OF THE K MESONS IN GAUGE THEORIES. Gaillard, M.K.; Lee, B.W. (National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 10: No. 3, 897-916 (1 Aug 1974).

Rare decay modes of the kaons such as $K \to \mu\bar{\mu}$, $K \to \pi\nu\bar{\nu}$, $K \to \gamma\gamma$, $K \to \pi\gamma\gamma$, and $K \to \pi e\bar{e}$ are of theoretical interest since here we are observing higher–order weak and electromagnetic interactions. Recent advances in unified gauge theories of weak and electromagnetic interactions allow in principle unambiguous and finite predictions for these processes. The above processes, which are "induced" $|\Delta S| = 1$ transitions, are a good testing ground for the cancellation mechanism first invented by Glashow, Iliopoulos, and Maiani (GIM) in order to banish $|\Delta S| = 1$ neutral currents. The experimental suppression of $K_L \to \mu\bar{\mu}$ and nonsuppression of $K_L \to \gamma\gamma$ must find a natural explanation in the GIM mechanism which makes use of extra quark(s). The procedure we follow is the following: We deduce the effective interaction Lagrangian for $\lambda + \mathcal{P} \to l + \bar{l}$ and $\lambda + \mathcal{P} \to \gamma + \gamma$ in the free quark model; then the appropriate matrix elements of these operators between hadronic states are evaluated with the aid of the principles of conserved vector current and partially conserved axial–vector current. We focus our attention on the Weinberg–Salem model. In this model, $K \to \mu\bar{\mu}$ is surpressed due to a fortuitous cancellation. To explain the small $K_L - K_S$ mass difference and nonsuppression of $K_L \to \gamma\gamma$, it is found necessary to assume $m_{\mathcal{P}}/m_{\mathcal{P}'} < 1$, where $m_{\mathcal{P}}$ is the mass of the proton quark and $m_{\mathcal{P}'}$ the mass of the charmed quark, and $m_{\mathcal{P}'} < 5$ GeV. We present a phenomenological argument which indicates that the average mass of charmed pseudoscalar states lies below 10 GeV. The effective interactions so constructed are then used to estimate the rates of other processes. Some of the results are the following: $K_S \to \gamma\gamma$ is suppressed; $K_S \to \pi\gamma\gamma$ proceeds at a normal rate, but $K_L \to \pi\gamma\gamma$ is suppressed; $K_L \to \pi\nu\nu$ is very much forbidden, and $K^+ \to \pi^+\nu\nu$ occurs with the branching ratio of $\sim 10^{-10}$; $K^+ \to \pi^+ee$ has the branching ratio of $\sim 10^{-6}$, which is comparable to the presently available experimental upper bound. The predictions of other models are briefly discussed. Relevant renormalization procedures and computational details are discussed in appendixes. (auth)

9815 BOUNDS WHICH DEPEND ONLY ON THE VECTOR FORM FACTORS IN QUASIELASTIC NEUTRINO REACTIONS. Oliver, L. (Laboratoire de Physique Théorique et Hautes Energies, Université Paris–Sud, 91405 Orsay, France); Pham, T.N. Phys. Rev. D 10: No. 3, 993-998 (1 Aug 1974).

In quasielastic neutrino– (antineutrino–) nucleon reactions, we obtain strict upper bounds for the ratio

$$R = \left(\frac{d\sigma}{d|q^2|}(\nu) - \frac{d\sigma}{d|q^2|}(\bar{\nu})\right) \Big/ \left(\frac{d\sigma}{d|q^2|}(\nu) + \frac{d\sigma}{d|q^2|}(\bar{\nu})\right)$$

at any neutrino energy E_ν and for the transverse and longitudinal polarizations of the recoil nucleon in the reaction plane at high neutrino energy ($E_\nu \gg$ nucleon mass) which depend only on the vector form factors. These bounds are constraints to be satisfied by experiments if the conserved–vector–current hypothesis is valid. (auth)

9816 CALCULABILITY AND NATURALNESS IN GAUGE THEORIES. Georgi, H. (Lyman Laboratory, Harvard University, Cambridge, Massachusetts 02138); Pais, A. Phys. Rev. D 10: No. 2, 539-558 (15 July 1974).

Calculability conditions are discussed for local gauge theories with Higgs–type symmetry breaking. We focus on the naturalness of μe universality, the naturalness of the Cabibbo angle θ, the naturalness of CP–violating phases, and the naturalness of the nonleptonic $\Delta I = 1/2$ rule. In this context we examine many published gauge models and construct others to illuminate the questions at hand. We note that naturalness of μe universality for charged currents does not necessarily imply universality for neutral currents (natural "restricted" universality), and we emphasize the need for ν_e–beam experiments. For $SU(2) \times U(1)$ and $SU(2) \times U(1) \times U(1)$ we give first examples of how a nontrivial natural θ can appear. Models with CP violation are classified as to whether their CP–violating phases are natural or not. For $O(4) \times U(1)$ we give a first example in which all the above naturalness criteria can be implemented. Here the natural μe universality is necessarily restricted. The principal tool used in these investigations is the strict renormalizability relative to a gauge group enlarged by discrete group to irreducible ones under the enlarged group. To implement this program, it is sometimes necessary to introduce Higgs couplings involving right–handed neutrinos; here the zero neutrino mass is associated with a discrete symmetry which remains unbroken upon spontaneous breakdown. We also find that strict renormalizability can lead to mass relations between fermions. In $O(4) \times U(1)$ models, such mass relations as well as right–handed neutrinos are necessary ingredients. Furthermore, for these models the spontaneity of CP violation acquires an operational significance, namely, as a discrete symmetry necessary (but not sufficient) to give a CP–violating phase a natural value (90°). While the models we discuss are rather cumbersome, particularly due to the complexity of the symmetry–breaking mechanism, we expect that the tools we have developed may well have wider applicability. (auth)

9817 THE STRUCTURE OF ANOMALOUS LEPTON HADRON INTERACTIONS AND $\pi^0 \to e^-e^+$. Soni, A. (Columbia Univ., New York (USA). Dept. of Physics). Phys. Lett., B; 52: No. 3, 332-334(14 Oct 1974).

The contribution of anomalous lepton–quark (hadron) interaction $\sim \bar{l} O_\mu q X_\mu$ to $\pi^0 \to e^-e^+$ is very strongly dependent on the form of O. Unless experiments reveal an unexpectedly large branching ratio ($\gg 10^{-8}$) for the process, O must have (V–A) or (S–P) structure. (auth)

9818 OCTET ENHANCEMENT OF NON-LEPTONIC WEAK INTERACTIONS IN ASYMPTOTICALLY FREE GAUGE THEORIES. Altarelli, G. (Rome Univ. (Italy). Istituto di Fisica); Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori de Fisica). Phys. Lett., B; 52: No. 3, 351-354(14 Oct 1974).

Octet enhancement of weak non leptonic amplitudes is found to occur in asymptotically free gauge theories of strong interactions, combined with unified weak and e.m. interactions. The order of magnitude of the enhancement factor for different models is discussed. (auth)

Strong (General)

Refer also to abstracts 9930, 10177, 10182, 10183, and 10222.

9819 (KEK-73-10, pp 239-271) HADRON SYMMETRY AND QUARKS. Matsuda, S. (Kyoto Univ.). Dec 1973.

From proceedings for high energy physics; Ibaraki, Japan (17 Jul 1973).

Lectures on the recent development of hadron symmetry and quarks are given. An introductory review and the very recent progress in this field are presented. An idea is given of how new developments were achieved step by step by recognizing the old difficulties. (JFP)

9820 RELATIVISTIC STRINGS AND SUPERGAUGES. Zumino, B. (CERN, Geneva). pp 367-381 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

Lectures are given which describe the hadronic world and some of its ramifications. The main point is that a field theory, such as a quark field theory with a gluon, even if it could be in principle correct, is hopelessly remote from the properties of hadrons one is interested in. The Nambu–Goto action, the relativistic string as a vortex line, and fermions and spin are covered. (JFP)

9821 VERTEX FUNCTION IN THE STRING MODEL OF HADRONS. Goto, T.; Naka, S. (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 51: No. 2, 600-612(Feb 1974).

From the viewpoint of the interactive bond which is a kind of interpretation of the quark, the vertex functional is constructed in the string model of mesons. The vertex functional obtained is really symmetric with respect to three strings participating in interactions. As an application of the vertex functional, the scattering amplitude of two strings in the ground state is calculated. (auth)

9822 QUARK "BAGS" AND LOCAL FIELD THEORY. Creutz, M. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 10: No. 6, 1749-1752 (15 Sept 1974).

We show how the "bag" model of Chodos, Jaffe, Johnson, Thorn, and Weisskopf for confining quarks within extended hadrons can be realized as a limit of a conventional local field theory. (auth)

9823 STATISTICAL DESCRIPTION OF HADRON CONSTITUENTS AS A BASIS FOR THE FLUID MODEL OF HIGH–ENERGY COLLISIONS. Hwa, R.C. (Institute of Theoretical Science and Department of Physics, University of Oregon, Eugene, Oregon 97403). Phys. Rev. D 10: No. 7, 2260-2268 (1 Oct 1974).

The pionization process in high–energy collisions is considered in a constituent–fluid model. The fluid picture describes the macroscopic behavior of the hadronic matter under expansion before the formation of physical pions. The constituent picture provides the microscopic basis for the fluid description. Assuming that the hadronic matter is a highly degenerate fermion system, the density and temperature variations during the expansion phase are derived. The single–particle inclusive distribution is shown to be scale–invariant and constant in rapidity. (auth)

9824 EQUIVALENT EXCLUSIVE AND INCLUSIVE MULTIPERIPHERAL DESCRIPTIONS. Pinsky, S.S. (Physics Department, Ohio State University, Columbus, Ohio 43210); Thomas, G.H. Phys. Rev. D 10: No. 7, 2237-2248 (1 Oct 1974).

It is shown that for each exclusive model satisfying a multiperipheral principle, there is an inclusive model satisfying a multiperipheral principle which predicts the same values for all exclusive and inclusive differential cross sections. The converse statement is also true. The relation between these models is thus one to one; we give formal expression for the transformation between one model and the other. These expressions have the form of the nonrelativistic Lippmann–Schwinger equation. The proof is given first for multi–Regge models having poles and cuts as the J–plane singularities. It is then generalized to models with multiparticle thresholds. The physical origin of such thresholds is discussed. Also treated are the further generalizations of the proof to models having N quantum number channels and to models having any general multiperipheral structure. (auth)

9825 COSMIC RAYS AND PARTICLE PHYSICS AT EXTREMELY HIGH ENERGIES. Gaisser, T. K. (Franklin Inst., Swarthmore, PA). J. Franklin Inst.; 298: No. 4, 271-287(Oct 1974).

Cosmic ray extensive air shower observations can give clues about the properties of high energy particle interactions above 10^{15} eV, in addition to giving information about the primary cosmic ray spectrum at these energies. A brief review of recent high energy accelerator data and its theoretical interpretation is given to explain the necessity for obtaining information from cosmic rays about hadronic interactions beyond machine energies. In particular, it is shown that recent measurements of the energy dependence of total cross sections and of production cross sections suggest some sort of threshold behavior in the 1000 GeV region. Studies at higher energies are required to understand the nature of this behavior. The use of air shower data for this purpose is illustrated by comparing shower size vs depth measurements with the expectations of various models of strong interactions. (auth)

9826 ABSORPTIVE CORRECTIONS TO MULTIHADRON PRODUCTION AND THE UNIT INTERCEPT OF THE POMERON. Harari, H. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Phys. Lett., B; 51: No. 5, 479-482(2 Sep 1974).

A simple absorptive model for multihadron production is proposed in which the zero strength limit ($g \rightarrow 0$) of the strong interactions is a vector theory, the Pomeron intercept is predicted to be at $\alpha p = 1$ for any value of g, and the leading non-Pomeron singularity is at $\alpha_R = 1 - g/2$. The model can accommodate correlations and incorporates the unitarity (Froissart) bound. Other properties of the model are discussed. (auth)

9827 DUAL MODELS AND RELATIVISTIC QUANTUM STRINGS. Rebbi, C. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Rep.; 12: No. 1, 1-73(Aug 1974).

The string picture of the dual resonance model is reviewed. It is shown that, if for a relativistic string propagating through space-time an action proportional to the area of the surface of evolution is assumed, the spectrum of states of the corresponding quantum system coincides with the spectrum of states of the conventional dual resonance model and contains only transverse excitations if suitable consistency conditions are met. It is also shown how an interaction among strings can be introduced so as to obtain the dual amplitudes as quantum mechanical transition amplitudes. The main properties of the spectrum of the closed string (Pomeron sector of the conventional duel model) and a generalization to include spin degrees of freedom are discussed. Throughout the article, the results obtained in the theory of the string are compared with the results obtained in the conventional approach to dual models. The reader is assumed to have some familiarity with the general properties of dual models. The review of G. Veneziano in Physics Reports, for instance, may provide the required introduction. (auth)

9828 THE CLASSIFICATION AND DECAYS OF RESONANT PARTICLES. Rosner, J. L. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Phys. Rep.; 11: No. 4, 189-326(Jul 1974).

544 refs.

The classification of resonant particles and some currently popular symmetries for describing their decays are reviewed. Experimental developments are brought up to date. The successes of SU(3), Regge trajectories, and the quark model are noted. Recent models for decays based on quark pair creation or on transformation between two kinds of quarks are discussed, and their relation to each other and to $SU(6)_W$ is mentioned. Sections are devoted to duality, whose most specific predictions remain to be confirmed, and to the scalar mesons, whose spectrum and decays may be relevant to considerations of broken scale invariance. Suggestions are made for future experimental work. (auth)

9829 HIGH-ENERGY HADRON PRODUCTION AND INCLUSIVE REACTIONS. Slansky, R. (Yale Univ., New Haven, Conn. (USA). Dept. of Physics). Phys. Rep.; 11: No. 3, 99-188(Jul 1974).

104 refs.

Recent data on multiparticle production at high energies are reviewed. The major topics include exclusive analyses, multiplicity distributions, single-particle inclusive spectra, and correlations. An effort is made to explore the physical significance of these results. (auth)

9830 TWO-BODY QUANTUM NUMBER EXCHANGE FROM MANY PARTICLE PRODUCTION DATA. Grassberger, P.; Michael, C.; Miettinen, H. I. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 52: No. 1, 60-64 (16 Sep 1974).

An analysis of the charge flow distribution and charge correlations from multiparticle data leads, via unitarity considerations, to an understanding of the nature of charge exchange in two-body reactions. (auth)

9831 A MULTI-REGGE MODEL FOR SELF-CONSISTENT POMERON WITH UNIT INTERCEPT. Banerjee, H.; Basu, U. (Saha Inst. of Nuclear Physics, Calcutta (India)); Mallik, S. (Tata Inst. of Fundamental Research, Bombay (India)). Phys. Lett., B; 52: No. 1, 81-83(16 Sep 1974).

A multi-Regge model is proposed with vanishing pomeron-pomeron-hadron vertex. The Regge-cut contributions from the inelastic cross section given by the model exactly cancels the contribution from the AFS-cut yielding a self-consistent factorizable pomeron pole with unit intercept. For small multiplicity the production cross sections are asymptotically independent of n and fall off as $(\ln s)^{-2}$. The correlation among the secondaries is, as usual, of short range order with the mean multiplicity growing as ln s. (auth)

9832 HADRON CLUSTERS WITH QUARK CORE AND MULTIPLICITY DISTRIBUTIONS. Csikor, F.; Farkas, I.; Montvay, I. (Eotvos Lorand Tudomanyegyetem, Budapest (Hungary)). Nucl. Phys., B; 79: No. 1, 92-108(11 Sep 1974).

Multiplicity distributions of ground state hadrons (pseudoscalar and vector meson nonet and baryon octet and decuplet) are investigated in a model of hadron clusters based on subsequent hadron emission by quarks. The effects of resonance decay for the observed (stable) hadron multiplicities are also considered. Average numbers of different hadrons are calculated as a function of the number of charged pions. The results are compared with available data and a good overall agreement is found. (auth)

9833 SECONDARY TRAJECTORIES IN REGGEON FIELD THEORIES. Abarbanel, H.D.I. (California Institute of Technology, Pasadena, California 91109 and National Accelerator Laboratory, Batavia, Illinois 60510); Sugar, R.L. Phys. Rev. D 10: No. 2, 721-731 (15 July 1974).

We study the corrections to any secondary Regge trajectory arising from repeated exchange of the Pomeranchuk singularity. Using renormalization—group methods we are able to determine the form of all Pomeron, Reggeon Green's functions in the neighborhood of $J = \alpha(0) = 1$ for the Pomerons and $J = \alpha_R(0) \simeq 1/2$ for the Reggeons. Starting with bare linear trajectories for both Pomerons and Reggeons we establish how these are modified by a triple—Pomeron and a two—Reggeon—Pomeron coupling. In an expansion of the theory around $D = 4$ space dimensions ($D = 2$ is where physics takes place), we find three allowed stable points of the renormalization—group equations in the infrared [$J \to 1$ or $\alpha_R(0)$] limit. For each of these we study the renormalized Reggeon trajectories and the structure of the Green's functions. (auth)

9834 VACUUM POLARIZATION AND THE ABSENCE OF FREE QUARKS. Casher, A.; Kogut, J.; Susskind, L. (Tel Aviv University, Ramat—Aviv, Tel Aviv, Israel). Phys. Rev. D 10: No. 2, 732-745 (15 July 1974).

This paper is addressed to the question of why isolated quark partons are not seen. It is argued that in vector gauge theories it is possible to have the short—distance and light—cone behavior of quark fields without real quark production in deep—inelastic reactions. The physical mechanism involved is the flow of vacuum—polarization currents which neutralize any outgoing quarks. Our ideas are inspired by arguments due to Schwinger and an intuitive picture of Bjorken. Two—dimensional (1 space, 1 time) vector gauge field theories provide exactly soluble examples of this phenomenon. The resulting picture of deep—inelastic final states predicts jets of hadrons and logarithmically rising multiplicities as conjectured by Bjorken and Feynman. (auth)

9835 REGGEON CALCULUS FOR $\alpha > 1$. Bronzan, J.B. (National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 10: No. 2, 746-754 (15 July 1974).

We study the Reggeon calculus when Reggeons have $\alpha(0) > 1$ and vacuum quantum numbers. We sum all the Regge cuts in the weak—coupling regime where the p Reggeon couplings r_p are small. The resulting amplitude saturates the Froissart bound, provided the triple—Regge coupling r_3 is dominant. In impact—parameter space the amplitude is a uniform absorbing disk whose radius expands like lns. The leading asymptotic term factorizes even when there are arbitrary couplings of the external particles to many Reggeons. In the angular momentum plane the Pomeranchon is a pair of cuts on the trajectories $\alpha_P(t) = 1 \pm 2[\alpha' (\alpha - 1)t]^{1/2}$. (auth)

9836 LOCAL AND GLOBAL EFFECTS OF DIFFRACTIVE PRODUCTION. Fried, H.M.; Soh, K. (Physics Department, Brown University, Providence, Rhode Island 02912). Phys. Rev. D 10: No. 2, 636-644 (15 July 1974).

Blankenbecler's theorem on threshold effects of diffractive production is examined in an eikonal context for local fluctuations (at the same energy) and global variations (over and energy range). Extensions are given to include possible multiplicity fluctuations. In the same model, Blankenbecler's result $\delta\sigma_{tot}/\delta\sigma_{diff} < 0$ is shown to hold when approximate sums are taken over all planar and nonplanar (checkerboard) graphs. (auth)

9837 THREE TRIPLETS, PARAQUARKS, AND "COLORED" QUARKS. Nambu, Y. (The Enrico Fermi Institute, and the Department of Physics, The University of Chicago, Chicago, Illinois 60637); Han, M. Phys. Rev. D 10: No. 2, 674-683 (15 July 1974).

We investigate the interconnection between various "nine—quark" models of hadrons: paraquarks of order 3, tri—"color" Gell—Mann quarks, our distinguishable three triplets with $SU(3)' \times SU(3)''$ symmetry, and another version with $SU(3)' \times SO(3)$ symmetry. A natural framework in which to distinguish one model from another is provided by a recent theorem by Ohnuki and Kamefuchi on the equivalence relation between a para—Fermi field of order p and a Fermi field with a hidden variable which takes on p different values. Owing to the difference in charge assignment that is natural to each model, the e^+e^- annihilation ratio R [$= \sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-)$] is equal to 2, 4, and 8 for para— (color) quarks, our triplets, and (fractionally—charged) triplets with $SU(3)' \times SO(3)$ symmetry, respectively. The experimental data may be interpreted to favor distinguishable triplet models. We then study the dynamics of superstrong interactions implied by the two versions of distinguishable triplet models, and find the $SU(3)''$ variety to be favored. Assuming integral charge and baryon—number assignment, we discuss the gross mass spectrum of hadrons. Single quarks will have a mass of ~2 GeV, and decay into ordinary baryons or antibaryons. (auth)

9838 SIMPLE SOLUBLE BOOTSTRAP MODEL WITH REGGE BEHAVIOR FOR INCLUSIVE REACTIONS. Yaes, R.J. (Department of Physics, Memorial University of Newfoundland, St. John's, Newfoundland, Canada). Phys. Rev. D 10: No. 3, 941-952 (1 Aug 1974).

We show that a large class of multiperipheral models satisfy the bootstrap integral equation obtained by Krzywicki and Petersson and by Finkelstein and Peccei. We relate the leading—particle distribution directly to the parameters of the multiperipheral model. We present a simple one—dimensional model, closely related to the Chew—Pignotti model, for which the bootstrap equations are exactly soluble and we discuss the properties of the solution. We show how the bootstrap integral equations can be modified to provide a two—component model containing both pionization and diffraction. (auth)

9839 INVESTIGATION INTO DUAL PARAFIELD EXCITATIONS. Hopkinson, J.F.L. (Science Research Council, Daresbury Laboratory, Daresbury, Nr. Warrington, Lancashire, England); Tucker, R.W. Phys. Rev. D 10: No. 2, 558-572 (15 July 1974).

A number of new dual models are presented. They use operators which satisfy parastatistics commutation relations. The properties of these operators are outlined, and the construction of L and G gauge operators from them is described. New amplitudes in which these paraoperators occur instead of, or in addition to, the usual operators are given, and their properties outlined. (auth)

9840 SPONTANEOUS SYMMETRY BREAKING WITHOUT SCALAR MESONS. Cornwall, J.M. (Division de Physique Théorique, Institut de Physique Nucléaire, 91406—Orsay, France and Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 10: No. 2, 500-517 (15 July 1974).

Recently, the formulation of spontaneously broken gauge theories (SBGT) without scalar mesons was carried out nonperturbatively for Abelian gauge models. These results are reformulated and extended to non—Abelian gauge theories using an effective Lagrangian, which allows symmetry—breaking coefficients to be calculated in perturbation theory. These coefficients appear in Callan—Symanzik equations for the SBGT, which differ only in what is conventionally called the right—hand side from the Callan—Symanzik equations for the symmetric theory. Spontaneous breakdown can only take place if these symmetry—breaking coefficients are positive, in which case the effective Lagrangian reduces, in a certain sense, to the Lagrangian of the symmetric theory. The question of positivity is studied in non—Abelian theories in lowest—order perturbation theory, and it is shown how to accommodate SBGT without scalars in the framework of asymptotic freedom. Some aspects of the utility of the light—cone gauge for calculations in non—Abelian theories are discussed in an appendix. (auth)

9841 DISTRIBUTION FUNCTIONS FOR COLLISIONS AT FINITE HIGH ENERGY IN THE FRAGMENTATION MODEL. Gien, T.T. (The Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 10: No. 3, 977-982 (1 Aug 1974).

The distribution functions for collisions at finite high energy in the fragmentation model are calculated and plotted for different energies with the number of production particles taken to be finite. The results show that while the characteristic behaviors of these distribution functions in the x variable (relative longitudinal momentum in the c.m. system) are still in qualitative agreement with experimental data, those in the y variable (rapidity) change drastically at small values of y. (auth)

9842 LIGHT—QUARK HADRON SPECTROSCOPY: A GEOMETRIC QUARK MODEL FOR S STATES. Mac Gregor, M.H. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. D 10: No. 3, 850-883 (1 Aug 1974).

A geometric light—quark model is described in which all quark—quark binding energies are less than 5%. The quark states of this model are formed entirely from a single quantum M, which has the same principal quantum numbers as the kaon. M appears in a spinless configuration ($M \sim 70$ MeV) and also in a relativistically spinning configuration ($M_s \sim 110$ MeV) as the nucleon quark $S \equiv 3M_s \sim 330$ MeV. The mass ratio $M_s/M \sim 3/2$ is a calculated quantity. The model can be formulated with a total of ten quark—state parameters: the masses $M^0 = 70.0$ MeV, $M^* = 74.6$ MeV, $S^* = 330.6$ MeV, and $S^{**} = 336.9$ MeV; the hadronic binding energies $M\overline{M} = -5.0$ MeV,

$M\tilde{M}_s = -5.0$ MeV, and $M_s\tilde{M}_s = -9.1$ MeV; a magnetic binding energy $S^+S^+ = \pm 1.7$ MeV; a magnetic moment $\mu_{S\pm} = \pm 9.3$ nuclear magnetons (μ_N); and a radius $R_M \simeq 0.6$ fermi. The spin angular momentum $J = 1/2\ \hbar$ of the spinor S is a calculated quantity, and the model also includes small calculated Coulomb corrections arising from multiple internal charges. With this formulation, the masses of all of the fundamental narrow—width hadron resonances are calculated to an average absolute accuracy of ±0.1%, or ±1 MeV, and spins, charge splittings, magnetic moments, and strangeness quantum numbers are reproduced. These calculated mass values are accurate enough to pinpoint the M meson as the fundamental ground—state member of the M(953), η' (958), δ^0(963) multiplet, a result that is experimentally confirmed by both the production modes and the decay modes for these mesons. (auth)

9843 STRONG INTERACTIONS AT LARGE TRANSVERSE MOMENTUM. II. Landshoff, P.V.; Polkinghorne, J.C. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). Phys. Rev. D 10: No. 3, 891-896 (1 Aug 1974).

Models for the production of particles at large transverse momentum are reexamined in the light of recent experimental data. A covariant analysis is given of the Berman—Bjorken—Kogut model, with a suitably general form assumed for the parton—parton scattering amplitude. An explicit model of the quark fusion type, developed in a previous paper, in recalculated using new values of a parameter obtained from data for meson production, and agrees well with that data. A model is discussed which could give copious production of protons at large transverse momentum. (auth)

9844 MODEL FOR ELASTIC SCATTERING AT WIDE ANGLE. Landshoff, P.V. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). Phys. Rev. D 10: No. 3, 1024-1030 (1 Aug 1974).

In a model for wide—angle elastic scattering each of the hadrons involved is pictured as being composed of a number of constituents. Each constituent of one hadron scatters at wide angle on at least one constituent of the other, in such a way that all the constituents remain near their mass shell. The resulting differential cross section is small because of the limited phase space available; it is required that all the constituents scatter through nearly the same angle, so that they can readily recombine to form the final—state hadrons. The differential cross sections calculated from the model have energy dependences that do not agree with those which would be obtained from simple dimensional counting, and indeed that mechanism of the model can dominate over other mechanisms that have been proposed for wide—angle scattering. The model is confronted with existing experimental data. (auth)

9845 REMARKS ON THE SEARCH FOR EXOTIC EXCHANGE. Hoyer, P.; Quigg, C. (State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics). Nucl. Phys., B; 80: No. 1, 127-134(4 Oct 1974).

Triple-Regge arguments suggest that exotic exchange contributions to peripheral processes should be relatively more important for the production of massive (thus unstable) particles. Experimental evidence bearing on this idea is surveyed, and implications for new experiments are discussed. (auth)

9846 THE ϵ EXPANSION OF POMERON AMPLITUDES. Baker, M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). Nucl. Phys., B; 80: No. 1, 61-76(4 Oct 1974).

The indices η, ν and γ, which characterize the high energy-behavior of the elastic scattering amplitude in the presence of a non-vanishing triple-pomeron interaction, are calculated to order ϵ^2, where $4-\epsilon$ is the dimension of the space of transverse momenta. At the physical value $\epsilon = 2$ these corrections to η and ν are larger than the ϵ terms calculated by Migdal, Polyakov, and Ter-Martirosyan and Abarbanel and Bronzan. (auth)

9847 ANGULAR CONSTRAINTS AND THE MELOSH TRANSFORMATION. Osborn, H. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 80: No. 1, 90-112(4 Oct 1974).

The Melosh transformation between current and constituent quarks is discussed when formulated on a light-like plane, as is natural for the description of collinear symmetries like $SU(6)_W$. There is no unique definition of the transformation in this context, but further angular constraints are introduced to ensure that the states coupled by $SU(6)_W$ transformations have the correct spin properties. It is then shown that there is no transformation generated by single quark operators which satisfies these requirements, save if only terms to first order in the transverse momentum are kept. Some of the resultant inconsistencies are illustrated by a discussion of baryon magnetic moments. It is concluded that there is no satisfactory explanation of $\mu_p/\mu_n = -3/2$ from this approach to the Melosh transformation. A non-field theoretic version of the free quark model which solves these angular constraints is exhibited. (auth)

9848 A MULTI-POMERON MODEL WITH ZEROS IN THE COUPLINGS. Moen, I. O.; Steinhoff, J. (McGill Univ., Montreal, Quebec (Canada). Dept. of Physics); Zakrzewski, W. J. (Durham Univ. (UK)). Nucl. Phys., B; 80: No. 1, 33-40(4 Oct 1974).

The violation of the Froissart bound resulting from repeated exchanges of pomerons in a multi-Regge model is avoided by assuming that some pomeron couplings vanish. The couplings can be chosen such that an input pomeron can produce an output pole coinciding with the input pomeron and a two-pomeron cut. The main aim is to show that the structure of pomeron couplings can play an important role in calculations involving many pomerons. (auth)

9849 THE CONTENT OF UNITARITY CONSTRAINTS ON A POMERON POLE OF INTERCEPT ONE. Cardy, J. L. (Science Research Council, Daresbury (UK). Daresbury Lab.); White, A. R. (National Accelerator Lab., Batavia, Ill. (USA)). Nucl. Phys., B; 80: No. 1, 12-32(4 Oct 1974).

A consistent picture of a pomeron pole with intercept one, together with its cuts, which evades the decoupling arguments is presented. The reggeon cut discontinuity formulae are used to introduce Gribov's reggeon calculus as an exact solution of multiparticle t-channel unitarity. It is shown how, within the calculus, two-pomeron iterations of a singular kernel can be responsible for the zero in the triple-pomeron vertex. By using the concept of a bare pomeron pole as a multiperipheral production process which is subsequently renormalized by other effects, the reggeon calculus analysis is applied to inclusive cross sections. It is found that the inclusive sum rule decoupling arguments are avoided because of the addition of enhanced absorptive corrections to the conventional Regge pole contributions. However, in this picture the combined pole and two-pomeron cut contribution to the total cross-section factorizes to order $(\ln s)^{-2}$. It is also shown that, when the correct helicity structure of the pomeron is taken into account, the s-channel unitarity condition for pomeron scattering amplitudes does not lead to any serious decouplings. (auth)

9850 ON THE TRANSFORMATION BETWEEN CURRENT AND CONSTITUENT QUARKS AND CONSEQUENCES FOR POLARIZED ELECTROPRODUCTION STRUCTURE FUNCTIONS. Close, F. E. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 80: No. 2, 269-298(11 Oct 1974).

The transformation of Buccella et al. and of Melosh is a rotation in spin space; thus, spin-dependent matrix elements are sensitive to this transformation, while spin-averaged quantities are not. This is explicitly shown by applying this transformation to the nucleon constituent space SU(6) wave function, and the generated current space wave function is seen to be simply a spin rotation of the constituent state. Matrix elements of current operators are then calculated with special emphasis on polarized electroproduction, where the results of Kuti and Weisskopf, which ignored this transformation, are vitiated. It is shown that the current quarks generated by this transformation cannot be identified with quark partons, and the properties of a more general operator which is a candidate for such a transformation are discussed. The nucleon octet states are decomposed into SU(6) parton configurations, and elastic and inelastic matrix elements within the octet are computed. The following sum rule is derived for the asymmetry in polarized electroproduction on polarized protons $\int_0^1 dx\, G_1^p\ (\chi) \simeq \frac{1}{3}\ (g_A/g_V)$, and the relation with previous sum rules is clarified. In the limit $x \to 1$ it is predicted that the polarization asymmetries from proton and neutron will be equal. (auth)

9851 MASSIVE QUARKS AND LARGE TRANSVERSE MOMENTA. I. Large-Angle Two-Body Scattering. Preparata, G. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 80: No. 2, 299-321(11 Oct 1974).

The ideas of the massive quark model are developed into an effective computational scheme for large-angle two-body hadronic scattering. The results resemble somewhat those of the interchange model of Blankenbecler, Brodsky and Gunion, but are derived in a different physical context, which does not suffer from the well-known difficulties of the standard parton model. (auth)

9852 A SEMICLASSICAL CALCULATION OF THE MASS SPECTRUM OF RELATIVISTIC STRINGS. Nahm, W. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Nucl. Phys., B; 81: No. 1, 164-178(25 Oct 1974).

Using a semiclassical description of relativistic strings it is shown that a certain transformation of their mass spectrum should yield a simple exponential function. This result applies in particular to the dual models at their critical dimension. It is also true for the experimental hadronic mass spectrum, up to energies where knowledge of it becomes incomplete. (auth)

9853 ON THE SCALE DEPENDENCE OF THE DIMENSION OF HADRONIC MATTER. Kraemmer, A. B.; Nielsen, H. B.;

Tze, H. C. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., B; 81: No. 1, 145-163(25 Oct 1974).

The notion of a dynamical, scale dependent Hausdorff dimension for hadronic matter is advanced. The physical motivations behind such a concept are explained. For very small scales, this dimension is related to the anomalous dimension of the product of two momentum densities. For hadrons, the precocious onset of Bjorken scaling in e-p inelastic scattering and a heuristic parton model are used to obtain the Hausdorff dimensional profile for the proton $d(q^2)$ as a function of the probing photon momentum q^2. It is found that d reaches a maximum around $d = 1$ for a range of low q^2 values. This feature is indicative of a string-like structure of the hadrons at low momentum transfers. (auth)

9854 ISOTOPIC MASS DIFFERENCE IN GAUGE MODELS OF STRONG, WEAK, AND ELECTROMAGNETIC INTERACTIONS. Kaganovich, A. B. (Chita Pedagogical Inst., USSR). Yadern. Fiz.; 20: No. 4, 839-840(Oct 1974). (In Russian).

A convergent expression within the framework of the gauge model is derived for the mass difference of ρ mesons. Experimental data indicating the validity of the expression are cited and briefly discussed. Direct test data on the mass difference of ρ mesons are ambiguous. (JSR)

9855 REGGE COUPLINGS AND INTERCEPTS FROM THE PLANAR DUAL BOOTSTRAP. Rosenzweig, C.; Veneziano, G. (Weizmann Inst. of Science, Rehovoth (Israel)). Phys. Lett., B; 52: No. 3, 335-340(14 Oct 1974).

Planar unitarization of dual models is examined in terms of renormalized diagrams. The shift of the Reggeon intercept $1-\alpha(O)$ and the renormalized coupling $g^2N/16\pi$ are both expected of order unity in a model with SU(N) Chan-Paton factors. In four space–time dimensions Regge behavior makes the shift of the dual photon mass reminiscent of Schwinger's mechanism. (auth)

Strong (Baryon No. = 0)

9856 (COO-2232B-53) APPLICATIONS OF CHIRAL PERTURBATION THEORY: MASS FORMULAS AND THE DECAY $\eta \rightarrow 3\pi$. Langacker, P.; Pagels, H. (Rockefeller Univ., New York (USA)). 1974. 44p. Dep. NTIS $5.25.

Several new results on the breaking of chiral SU(3) × SU(3) are presented within the theoretical framework of chiral perturbation theory. The leading order corrections to the Gell-Mann–Okubo formula for the baryon octet are shown to be of order $\epsilon^{1/2}$, where ϵ is a chiral breaking parameter. An explicit exact expression is given for the leading order corrections which provides a new development in understanding why this formula works so well. Similarly the corrections to the Gell-Mann–Okubo formula for the ground state pseudoscalar octet are shown to be of order $\epsilon^2 \ln \epsilon$ (including (η-η' mixing). On the basis of these exact results it is argued that SU(3) × SU(3) symmetry is as good as SU(3) symmetry ~30% except when one considers electromagnetic interactions. The $\eta \rightarrow 3\pi$ decay on the assumption that it is regulated by a nonelectromagnetic isospin violating term of the type $\epsilon_3 u_3$ with u_3 a member of $\bar{3}3 \oplus 3\bar{3}$. The strength ϵ_3 of this term is related to the experimental rate including all leading order chiral symmetry corrections. This estimate of ϵ_3 leads to $\Delta I = 1$ hadron level shifts about a factor of 2 or 3 too large, although the estimate of ϵ_3 depends sensitively on the experimental details. Octet enhancement, an exact formalism to describe η-η' mixing and other topics are discussed. (auth)

9857 (COO-2271-44) SPONTANEOUS CP NONCONSERVATION. Lee, T. D. (Columbia Univ., New York (USA)). 1974. 22p. (CONF-740731-2). Dep. NTIS $4.25.

From international school of subnuclear physics; Erice, Italy (14 Jul 1974).

The idea that the vacuum state, though Lorentz invariant, may resemble a medium and that this may explain why there is a large variety of missing symmetries is illustrated by giving a simple example in connection with CP nonconservation. The various neutral kaon decays are considered. (JFP)

9858 (FUPH-R-100) FADDEEV APPROACH TO PION PRODUCTION AND PION DEUTERON SCATTERING. Afnan, I. R.; Thomas, A. W. (Flinders Univ. of South Australia, Bedford Park. School of Physical Sciences). Feb 1974. 64p. Dep. NTIS (US Sales Only) $6.25.

Some consequences of a new approach to pion production near threshold are explored. This is considered to be essentially a three-body reaction, and use the Faddeev equations to calculate the relevant scattering amplitudes. The description of the $NN\pi$ vertex is justified by using the model in a successful calculation of the long-range part of the N-N scattering amplitude. The results of this model for pion production confirm a sensitivity to the short range behavior of the deuteron wave function, and its D-state probability, reported earlier. (That is, it seems likely that pion production may be useful in distinguishing between the various realistic N-N potential models.) A stronger variation of the production amplitude with energy than has previously been reported was also found. This may resolve the apparent incompatibility of some experimental results. Finally, the implications of the model are also discussed for pion-deuteron elastic scattering. In particular it is shown how a formula published in a preliminary report of this work is in agreement with a recent measurement of the pion-deuteron scattering length. (auth)

9859 (JINR-P2-8111) SPECTRAL FUNCTION OF ONE-PARTICLE MATRIX ELEMENT $[0][V_\mu^{4-i5}(x), A_\nu^3(0)][K^+(k)]$ AND CONDITIONS OF LOCAL COMMUTATIVITY. Fakirov, D. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 28p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

An expression is found in explicit form for the spectral function of the matrix element $<0|[V_\mu^{4-i5}(x), A_\nu^3(0)]|K^+(k)>$, which satisfies the requirements of local commutativity. The locality results as a consequence of definite conditions imposed on the set of intermediate states used in the saturation of the commutator $[V_\mu^{4-i5}(x), A_\nu^3(0)]$. (auth)

9860 (LBL-3091) MESON SPECTROSCOPY. Wagner, F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1974. Contract W-7405-eng-48. 58p. (CONF-740713-33). Dep. NTIS $6.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

The review of meson spectroscopy covers $\pi\pi$ and $K\pi$ elastic scattering and the 3π and $K\pi\pi$ analyses, formation experiments in $N\bar{N}$ and miscellaneous results. (JFP)

9861 ANALYTIC RENORMALIZATION OF THE SIGMA-MODEL. Marinaro, M.; Mercaldo, L.; Vilasi, G. (Univ., Salerno, Italy). pp 189-217 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

The renormalization of the σ-model is studied in the scheme of the analytic regularization. It is shown that by using a suitable analytic regularization it is possible to verify the Ward–Takahashi identities at every stage of the computation. (auth)

9862 REGULARIZATION AND RENORMALIZATION OF NONLINEAR PION–PION COUPLINGS. Barua, D.; Gupta, S.N. (Department of Physics, Wayne State University, Detroit, Michigan 48202). Phys. Rev. D 10: No. 6, 1945-1955 (15 Sept 1974).

The fourth–order $\pi-\pi$ scattering resulting from nonlinear pion–pion couplings is investigated to show how such couplings can be regularized by the method of auxiliary fields. Special care is required in the choice of coupling terms involving the auxiliary fields to ensure that all quartic divergences are canceled by the δ (0) terms in the regularized effective interaction. It is found that four counterterms are necessary for the elimination of divergences in the process under consideration. In the limiting case of massless pions, the $\pi-\pi$ scattering result is free from infrared divergence, satisfies Adler's condition, and requires only two counterterms for renormalization. (auth)

9863 FACTORIZATION AND SHIELDING OF HARD REGGE SURFACES. Oehme, R.; Paranjape, S. (The Enrico Fermi Institute, and the Department of Physics, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. D 10: No. 7, 2229-2233 (1 Oct 1974).

Hard branch–point trajectories require shielding cuts in order to be compatible with elastic unitarity. For coupled channels like $\pi\pi$ and $N\bar{N}$, shielding of the two–pion threshold is required for all amplitudes if the hard branch point factorizes. Explicit examples are given, for the shielding of the lowest as well as the higher thresholds. (auth)

9864 QUARK MODEL FOR HIGH–ENERGY $\bar{p}N \rightarrow PP$ REACTIONS. Chand, R. (Himachal Pradesh University, Department of Physics, The Manse, Simla–1 (H.P.), India). Phys. Rev. D 10: No. 7, 2191-2193 (1 Oct 1974).

In our broken–SU–(3) quark model, high–energy processes of the type $\bar{p}N \rightarrow PP$ are investigated in the crossed–t channel. It is assumed that the physical baryon octet contained in the direct product $\underline{3} \otimes \underline{3} \otimes \underline{3}$ is given by $\underline{8}$ (physical) = $\underline{8}' \cos\theta + \underline{8} \sin\theta$, where the baryon octets $\underline{8}$ and $\underline{8}'$ arise from $\underline{3} \otimes \underline{3}$ and $\bar{\underline{3}} \otimes 6$, respectively. We find that the available data on $R(\pi^+\pi^-)$: $R(K^+K^-)$: $R(K^-\bar{K}^0)$ are in reasonable agreement with our calculations for $\theta = 20^\circ$ and $b = 0.2 \pm 0.04$; b is the strange–quark–to–nonstrange–quark coupling parameter. (auth)

9865 DETERMINATION OF THE $N\bar{N} \rightarrow \pi\pi$ HELICITY AMPLITUDES. Epstein, G.N.; McKellar, B.H.J. (School of Physics, University of Melbourne, Parkville, Victoria, Australia 3052). Phys. Rev. D 10: No. 7, 2169-2182 (1 Oct 1974).

General consistency conditions are derived for the $N\bar{N} \rightarrow \pi\pi$ helicity amplitudes. These are used to check previous determinations and then incorporated into a new calculation scheme to determine both s– and p–wave helicity amplitudes. (auth)

9866 BROKEN SCALE INVARIANCE IN $p\bar{p} \rightarrow l^+l^-$ + ANYTHING IN FUNCTIONAL APPROACH TO QUANTUM FIELD THEORY. Chowdhury, A. R.; Roy, T. (Jadavpur Univ., Calcutta). Lett. Nuovo Cim.; 11: No. 13, 599-602(20 Nov 1974).

The functional methods of quantum field theory were applied to the lepton pair production in pp annihilation. The investigation reveals the breakdown of scale invariance due to the appearence of log x^2-type singularities on the light cone, not obtainable in the usual perturbative approach. (JFP)

9867 K_S–K_L-MESON MASS DIFFERENCE. Pervushin, V. N.; Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Phys. Lett., B; 51: No. 5, 499-500(2 Sep 1974).

The chiral-invariant phenomenological Lagrangians are successfully exploited for studying the low-energy processes within quantum theory of strong interactions, with the use of the analytic superpropagator (SP) method of regularization. According to this method, to eliminate the ultraviolet divergences in quantum field theory it is sufficient to employ the essential nonlinearity of a Lagrangian. In this note it is shown that quantum theory with the dynamical chiral symmetry of hadron interaction leads to a physically simple interpretation for the $K_S - K_L$-meson mass difference. (NL)

9868 ZEROS OF THE $\pi^+\pi^- \rightarrow \pi^+\pi^-$ AMPLITUDE. Bugg, D. V. (Queen Mary Coll., London (UK)). Phys. Lett., B; 52: No. 1, 102-204(16 Sep 1974).

Recent data on the reaction $\bar{p}p \rightarrow \pi^-\pi^+$ show four conspicuous dips in the angular distribution at fixed values of ν = t-u. The conjecture is made that the channel $\pi^-\pi^+ \rightarrow \pi^-\pi^+$ has zeroes at the same ν values. Using data of the CERN-Munich group, one can follow the zeroes through the whole Mandelstam plane. The zeroes pass through the intersections of s and t channel poles, as the Veneziano model predicts; however, away from these intersections, they propagate in a fashion systematically quite different from Veneziano's ansatz. (auth)

9869 FORM FACTORS, THRESHOLD RELATIONS, AND LARGE ANGLE ELASTIC SCATTERING OF PIONS. Hughes, R. P. (Cambridge Univ. (UK)). Nucl. Phys., B; 79: No. 1, 153-167(11 Sep 1974).

The form factor $F(q^2)$ of the pion in a simple core model is investigated, together with the deep inelastic electroproduction structure function $F_2(\omega)$. A relation between these two, analogous to the Drell–Yan–West relation for nucleons, is derived, and it is found that F_2 is related to either the form factor or the square of the form factor depending on how rapidly $F(q^2)$ ultimately falls with momentum transfer. The unitarity equation and its implications for this kind of threshold relation are discussed. The simple core model is also applied to elastic large angle $\pi\pi$ scattering. (auth)

9870 ROLE OF THE PION MASS IN TRIPLE-REGGE PHYSICS. Shankar, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., B; 79: No. 1, 126-140(11 Sep 1974).

An extension is made of the investigations of Abarbanel et al., who examined asymptotic total cross sections in a multiperipheral model and obtained the surprising result that the scale for the cross sections is provided not by μ, the mass of the exchanged pion, (as anticipated on geometrical grounds) but by m_V, the central mass of the dominant low energy $\pi\pi$ resonance entering the kernel. The role of the pion mass in triple-Regge physics is clarified by examining the pion pole dominance model for the triple-Regge couplings g_{ijk}. It is found that m_V provides the scale for the inclusive link and that for this reason the couplings g_{ijk} depend very little on the intercept α_k of the exchanged reggeon. In the exclusive links if $i = j$ = pomeron, m_V once again is the only active energy scale, whereas if $i = j = R$, the reggeons of intercept 0.5 or less, the pion mass enters the couplings g_{RRk} in an essential way. It is shown that the smallness of μ^2/m_V^2 is responsible for the largeness of the ratios g_{RRk}/g_{PPk}. These features of the model, which are in qualitative agreement with experiment, are put to a quantitative test. (auth)

9871 COUPLINGS OF THE ρ' MESON IN THE QUARK–PAIR–CREATION MODEL. Kaufmann, W.B.; Jacob, R.J. (Arizona State University, Tempe, Arizona 85281). Phys. Rev. D 10: No. 3, 1051-1053 (1 Aug 1974).

We show that the quark–pair–creation model can account for the strong suppression of the 2π mode relative to the 4π mode in the decay of the ρ' meson. (auth)

9872 CALCULATION OF NUCLEON–NUCLEON TWO–PION EXCHANGE UTILIZING THEORETICAL AND EXPERIMENTAL $\pi\pi$, πN, AND eN INFORMATION. Bohannon, G.E.; Signell, P. (Department of Physics, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. D 10: No. 3, 815-823 (1 Aug 1974).

The $J = 0,1,2$, $N\bar{N} \rightarrow \pi\pi$ amplitudes are evaluated in the physical region of the two pions, $t \geq 4\mu^2$, and used in a dispersion–theoretic calculation of nucleon–nucleon two–pion–exchange. Experimental input to the evaluations of the $N\bar{N} \rightarrow \pi\pi$ amplitudes is via $\pi\pi$ phase shifts, πN scattering lengths, and πN phase shifts. The effect of varying the $I = J = 0$ $\pi\pi$ phase shift within its present uncertainty is investigated. Experimentally determined nucleon electromagnetic form factors are used in the evaluation of the $J = 1$ $N\bar{N} \rightarrow \pi\pi$ amplitude. After adding π and ω exchange to the two–pion–exchange amplitude, the theoretical phase shifts are compared with phase–shift–analysis results. The calculated $^1S_0$ potential is also shown and compared with the phenomenological one of Hamada and Johnston. (auth)

9873 RELATIVISTIC QUARK MODEL FOR MESONS. Walters, P. J.; Thomson, A. M.; Gault, F. S. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 14, 1681-1696(21 Sep 1974).

A relativistic quark model, which is closely related to the nonrelativistic harmonic oscillator model, is presented for mesons with spin-½ quarks. The conventional quark model spectrum is reproduced, with particles lying on straight line trajectories, although for PC = 1 states large masses are predicted. The relativistic approach used throughout gives rise naturally to spin-orbit terms. These terms are analogous to those which arise in the Melosh (Thesis. Caltech (1973)) approach. The comparisons of the model predictions with data is encouraging and the results include meson decay widths for emission of a pseudoscalar meson or a photon. (auth)

9874 $\pi\pi$ PHASE-SHIFT ANALYSIS BELOW THE $K\bar{K}$ THRESHOLD. Estabrooks, P.; Martin, A. D. (Durham Univ. (UK)). Nucl. Phys., B; 79: No. 2, 301-316(18 Sep 1974).

An energy independent $\pi\pi$ phase-shift analysis is performed in the energy range $0.5 < M_{\pi\pi} < 1$ GeV using high statistics $\pi^-p \rightarrow \pi^-\pi^+n$ data at 17.2 GeV/c. The method is based on an amplitude analysis of the production process and the extrapolation of the dominant π exchange amplitudes to the π exchange pole. The stability of the analysis is critically investigated, and the results compared with those of other analyses. The mass and width of the ρ resonances are determined to be 770 ± 9 and 143 ± 13 MeV respectively. (auth)

9875 $\bar{p}p$ ANNIHILATION CHANNEL AS A MEANS TO DISTINGUISH HIGH-ENERGY PRODUCTION MODELS. Chen, C. K. (Glasgow Univ. (UK). Dept. of Natural Philosophy). Nucl. Phys., B; 81: No. 1, 18-30(25 Oct 1974).

The possibility to use the $\bar{p}p$ annihilation channel as a means to distinguish high-energy hadron production models is pointed out, and the application of a multi-peripheral model to $\bar{p}p$ annihilation is discussed. Certain subtraction rules are proposed in order to avoid the necessity of separating the annihilation and non-annihilation events for high energy $\bar{p}p$ collisions. (auth)

9876 STUDY OF THE $I = \frac{1}{2}$ $K\pi$ SCATTERING AMPLITUDE. I. Threshold to 1 GeV Mass Region. Fox, G. C.; Griss, M. L. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 80: No. 3, 403-441(18 Oct 1974).

$K\pi$ scattering from threshold to 1 GeV in $K\pi$ mass is studied by modified Chew– Low extrapolation in the reactions $K^-p \rightarrow K^-\pi^+n$ and $K^+n \rightarrow K^+\pi^-p$. Although the cross section and moments of these two reactions differ significantly in the physical region, similar values are found for the $K\pi$ phases in the two processes. The necessary modifications of one pion exchange are sizeable and although they do not agree quantitatively with the poor man's absorption model, they can be understood in a more general absorption framework. The experimental $K\pi$ s-wave scattering length is much larger than naive current algebra predictions but consistent with a straight forward dispersion theory method of extrapolating current algebra to the physical region. (auth)

9877 BARYON– ANTIBARYON ANNIHILATIONS, UNITARITY AND THE POMERON. Eylon, Y.; Harari, H. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Nucl. Phys., B; 80: No. 3, 349-366(18 Oct 1974).

It is shown that baryon– antibaryon annihilation into mesons contribute, via unitarity, mainly to the pomeron term in the total $\bar{B}B$ cross section. The meson-exchange term is mainly built by non-annihilation processes. These results are contrary to previous ideas according to which $\bar{B}B$ annihilations are responsible for the difference between $\sigma_{tot}(\bar{B}B)$ and $\sigma_{tot}(BB)$ and contribute to the meson exchange term. Conclusions are based on an explicit duality diagram model which is discussed in some detail. However, a much wider class of models give similar results. Experimental tests of these ideas are proposed. (auth)

Strong (Baryon No. = 1)

9878 (JINR-P2-8051) USE OF THE REGGE PHENOMENOLOGY FOR DESCRIPTION OF THE INCLUSIVE REACTION $\pi^- p \to \pi^\pm X$. Grishin, V. G.; Yuldashev, B. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

It was shown that the experimental distributions of the structure functions for the fragments $p \xrightarrow{\pi^-} \pi^\pm$ at 40 GeV/c can be satisfactorily described by relations derived by the hypothesis of factorization of the Regge residue and exchange degeneration of meson trajectory in exotic channels. (tr-auth)

9879 (KEK-73-10, pp 175-201) GROSS STRUCTURE OF REACTION MECHANISM IN MULTIPARTICLE PRODUCTION PROCESS. Noda, H. (Ibaraki Univ., Mito, Japan). Dec 1973.

From proceedings for high energy physics; Ibaraki, Japan (17 Jul 1973).

The structure of the high energy hadron–hadron (π^- + p) interaction is investigated. The reaction mechanism of the multiple production process is treated as composed of the nondiffractive and diffractive mechanisms. The following points are clarified: when the final multiplicity is fixed, a dominant reaction mechanism of the production process switches over from the nondiffractive to the diffractive mechanism with increasing energy. On the other hand, the former (or latter) is dominant in reactions with large (or small) multiplicity at a fixed incident energy. It is shown that the structure of the reaction mechanism is characterized on the multiplicity–incident momentum plane. (JFP)

9880 (RL-74-139) PARTICLE EXCHANGE IN K^+p SCATTERING. Cottingham, W. N.; Davis, A. C.; Giddings, D. I. (Science Research Council, Chilton (UK). Rutherford Lab.). Sep 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

Recent phase shift analysis of K^+p scattering have shown many features of particle exchange. In exotic channels, particle exchange appears to play a more prominent role than in nonexotic channels where exchanges are obscured by direct channel resonances. Particle exchange was investigated, in the momentum range 0.9 to 1.5 GeV/c, using a phase shift analysis in which coupling constants were variable parameters. (auth)

9881 FORM FACTOR IN THE BETHE–SALPETER MODEL WITH EXPONENTIAL INTERACTION. Biswas, S.N.; Malik, G.P.; Singh, S. (Department of Physics and Astrophysics, University of Delhi, Delhi 110007, India). Phys. Rev. D 10: No. 6, 1981-1984 (15 Sept 1974).

The asymptotic behavior of the nucleon form factor is investigated, treating the nucleon as the bound state of its two constituent particles interacting via the exchange of an exponential field. It is suggested that the result that the form factor behaves as t^{-1} for $|t| \to \infty$ could be interpreted as signifying the localizability of the exponential theory. (auth)

9882 QUARK MODEL FOR $K^-p \to \pi\Sigma$, $\pi\Lambda$ REACTIONS AT LOW ENERGIES. Chand, R. (Himachal Pradesh University, Department of Physics, The Manse, Simla–1, India). Phys. Rev. D 10: No. 7, 2186-2190 (1 Oct 1974).

In our SU(3) quark model, $K^-p \to \pi\Sigma$, $\pi\Lambda$ reactions at low energies are investigated. The physical baryon octet is taken as $\underline{8}$ (physical) = $\underline{8}' \cos\theta + \underline{8} \sin\theta$, where the octets $\underline{8}$ and $\underline{8}'$ arise, respectively, from $\underline{3} \otimes \bar{\underline{3}}$ and $\underline{3} \otimes \underline{6}$ contained in the direct product $\underline{3} \otimes \underline{3} \otimes \underline{3}$ In terms of the mixing angle θ, our calculations are compared with the available data on (a) $\epsilon = R(\Lambda)/[R(\Sigma^+) + R(\Sigma^-) - 2R(\Sigma^0) + R(\Lambda)]$, (b) $R(\Lambda)/R(\Sigma^0)$, and (c) $R(\Sigma^0)/R(\Sigma^-)$, at p_L = 293 MeV/c. (auth)

9883 SPIN–ROTATION EFFECTS IN MESON–NUCLEON SCATTERING. Kelly, R.L. (Lawrence Berkeley Laboratory, Berkeley, California 94720); Sandusky, J.C.; Cutkosky, R.E. Phys. Rev. D 10: No. 7, 2309-2313 (1 Oct 1974).

A discussion is given of the theoretical description of spin–rotation effects in the scattering of a spinless projectile by a spin–1/2 target. Description of these effects in terms of the polarization parameter P and the Wolfenstein rotation angle β is shown to be especially convenient for a variety of experimental and theoretical purposes. The information obtainable from rescattering experiments is shown to be maximized when these are cast in the form of null experiments for the deviation of β from its anticipated value. (auth)

9884 STRUCTURE OF AMPLITUDES OF KN CHARGE–EXCHANGE REACTIONS. Argyres, E.N. (State University College of Arts and Science, Plattsburgh, New York 12901); Contogouris, A.P.; Holden, J.P. Phys. Rev. D 10: No. 7, 2095-2102 (1 Oct 1974).

On the basis of recent data on $K^-p \to \bar{K}^0 n$ polarization and on differential cross sections, we present an amplitude analysis for $K^-p \to \bar{K}^0 n$ and $K^+n \to K^0 p$. The approach makes use of fixed–t dispersion relations and of information in the low–energy (resonance) region. We present detailed comparison of our results with those of amplitude analyses of other reactions, and we underline a number of features of the vector and tensor exchange in common to several two–body hadron processes. A check of our results against finite–energy sum rules is also presented. (auth)

9885 GLOBAL DESCRIPTION OF $0^- 1/2^+ \to 0^- 1/2^+$ REACTIONS UTILIZING THE BARE POMERON. Bali, N.F. (Physics Department, University of Washington, Seattle, Washington 98195); Dash, J.W. Phys. Rev. D 10: No. 7, 2102-2118 (1 Oct 1974).

It is shown that the combination of a "bare Pomeron" with intercept $\hat{\alpha}_P(0) = 0.85$ in conjunction with a reasonable set of secondary Regge trajectories and a canonical absorption prescription is capable of providing a good global fit to practically all $0^- 1/2^+ \to 0^- 1/2^+$ meson–nucleon scattering data up to lab momenta of 30 GeV/c. The bare Pomeron with intercept lower than 1 has a large real part which greatly facilitates the description of the data. At higher energies, "renormalization" effects can be expected to be important as inelastic diffraction events, and these lead to a renormalized Pomeron intercept very close to or equal to one. The value $\hat{\alpha}_P(0) = 0.85$ used throughout this intermediate–energy fit is in agreement with current inclusive triple–Regge data and maximum–rapidity–gap distributions. It is also in agreement with certain strong–coupling ABFST (Amati–Bertocchi–Fubini–Stanghellini–Tonin) multiperipheral model calculations. For secondary effects, we have used a family of vector Regge trajectories (ρ, ω, K^*) with a degenerate intercept of about 0.45, and tensor trajectories (A_2, K^{**}) with an intercept of about 0.25. A second vacuum pole emerges with intercept close to 0. The P' (f) trajectory, not included here, can perhaps be expected to appear in conjunction with the renormalization of the Pomeron. Although no wrong–structure nonsense zeros are included in the parametrization, the $\rho - A_2$ and $K^* - K^{**}$ pole couplings are nevertheless very nearly exchange degenerate. SU(3) is used to relate most of the other couplings. The (pole + cut) helicity–flip $\rho - A_2$ and $K^* - K^{**}$ amplitudes also show considerable exchange–degenerate characteristics. We have used a standard absorption prescription to calculate the second–order bare Pomeron ($\hat{P}$) $\otimes$ Reggeon cuts and $\hat{P} \otimes \hat{P}$ cuts. An unusual result emerges—the "enhancement" λ_i factors for all cuts are less than one. This indicates the presence of higher–order cuts which thus dominate over inelastic intermediate–state production in this approach. The data used in this fit are a representative selection of $0^- 1/2^+ \to 0^- 1/2^+$ data (including πN amplitude analysis, hypercharge–exchange differential cross sections and polarizations; $\pi^\pm$ p and $K^\pm$ p total and differential cross sections, polarizations, and t = 0 real–to–imaginary ratios; and πN and KN charge–exchange differential cross sections and polarizations) up to p_{lab} = 30 GeV/c and $|t|$ = 1.5 $(GeV/c)^2$. (auth)

9886 A TEST OF GOR MODEL AND PCAC RELATIONS THROUGH THE MESON–BARYON σ-TERMS AND THE BBS COUPLING CONSTANTS. Sinha, P.; Gautam, V. P. (Indian Association for the Cultivation of Science, Calcutta. Dept. of Theoretical Physics). Phys. Lett., B; 51: No. 5, 472-474(2 Sep 1974).

A set of SU(3)-invariant BBS coupling constants with the same D/F ratio as the baryon masses is obtained through the meson–baryon σ-terms by the use of GOR Model and PCAC Relations. The possible role of the scalar mesons in determining the meson–baryon σ-terms is also analyzed. (auth)

9887 THE REAL PART OF Kp FORWARD SCATTERING WITH RISING TOTAL CROSS SECTIONS. Meyer, R. W. (Amsterdam Univ. (Netherlands). Zeeman Lab.); Winzeler, H. (Katholieke Universiteit Nijmegen (Netherlands). Fysisch Lab.). Nucl. Phys., B; 79: No. 1, 38-44(11 Sep 1974).

Forward dispersion relations were applied to Kp elastic scattering with the assumption that the total cross sections continue to rise with primary energy ω like log ω and $\log^2 \omega$ respectively. The results depend on the way of approach with ω of the two total cross sections. In this connection, the consequences of a generalized version of the Pomeranchuk theorem when total cross sections are rising like $\log^\beta \omega$ are further discussed. The ratio α^+ of real and imaginary parts of the forward elastic scattering amplitude for K^+p is seen to change sign, and becomes positive at some high energy (e.g. at about 400 GeV in the $\log^2$ case). If the total cross section difference behaves like $1/\omega^b$, then α^- will remain positive at all (high) energies. However, if the cross sections approach each other as slowly as allowed by the generalized Pomeranchuk theorem, then also α^- will change sign at some very high energy. (auth)

9888 DISPERSION–RELATION CALCULATION OF THE πN ELASTIC AMPLITUDE A FOR $0.20 \leqslant -t \leqslant 0.40$ (GeV/c)^2 AND 0.87 — p — 20.0 GeV/c. McClure, J.A. (Department of Physics, Georgetown University, Washington, D.C.); Pitts, L.E. Phys. Rev. D 10: No. 3, 843-849 (1 Aug 1974).

A method previously presented in which dispersion relations were written for the logarithm of the scattering amplitude is extended to larger values of momentum transfer. The earlier technique was applied to πN elastic scattering but was restricted to $-t \lesssim 0.24$ (GeV/c)^2 because of the crossing of the t–dependent threshold energy and the nucleon pole. That limitation is here removed by writing the dispersion relations for the amplitude with its pole removed and the thus extended method is again applied to πN scattering. The amplitudes $A_{\pm}$ calculated at pion lab momenta of 2, 4, 8, 12, 15, 20, and 30 GeV/c for $-t$ = 0.20, 0.25, 0.30, 0.35, 0.40 (GeV/c)^2 are presented. (auth)

9889 RIGOROUS LOWER BOUNDS ON THE IMAGINARY PARTS OF THE SCATTERING AMPLITUDES AND THE POSITIONS OF THEIR ZEROS. Uchiyama, T. (Department of Physics, Osaka City University, Osaka, Japan). Phys. Rev. D 10: No. 3, 999-1004 (1 Aug 1974).

On the basis of the analyticity and unitarity, rigorous lower bounds on the elastic scattering amplitudes are given in terms of the total cross section and the slope parameter. If we assume that the interaction radius R is independent of s and take R = 1 fm, the imaginary parts of the elastic scattering amplitudes must not have zeros for $-t \leqslant 0.45$ (GeV/c)^2 at high energies. A comparison with the CERN ISR data is given. (auth)

9890 AN S-CHANNEL AMPLITUDE ANALYSIS OF THE REACTION $\pi^+p \rightarrow \Delta^{++}\pi^0$ USING THE DUAL ABSORPTIVE MODEL. Bloodworth, I. J. (Glasgow Univ. (UK). Dept. of Natural Philosophy). Nucl. Phys., B; 80: No. 2, 230-238(11 Oct 1974).

The dual absorptive model proposed by Harari and extended by Loos and Matthews is shown to give a reasonable parametrization of the available data on $\pi^+p \rightarrow \Delta^{++}\pi^0$ over the momentum range 4–13 GeV/c. The different cross sections are well fitted using only the $\Delta\lambda = 0$ and $\Delta\lambda = 1$ amplitudes. Density matrix elements are compared with the model at 5.5 GeV/c. (auth)

9891 ARE THERE CHARMED QUARKS IN THE NUCLEON. Novoseller, D.; Ravndal, F. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 79: No. 2, 333-340(18 Sep 1974).

A simple relation between structure functions for deep inelastic leptoproduction off any nuclear target is presented to test for charmed quarks in the nucleon. In the case of SU(3) × SU(3) current symmetry, a similar relation for isoscalar nuclear targets is obtained. Existing CERN neutrino data are not accurate enough to draw any definite conclusions. (auth)

9892 POMERON DOMINANCE IN A TRIPLE-REGGE REPRESENTATION OF INCLUSIVE Δ^{++} PRODUCTION IN K^-p AND π^-p REACTIONS. Bosetti, P.; Kirk, H.; Matziolis, M. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Nowak, H.; Schreiber, H. J. (Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic)); Boeckmann, K.; Hartmann, R. (Bonn Univ. (F. R. Germany). Physikalisches Inst.); Bartke, J. (Institute of Nuclear Physics, Krakow (Poland)); Counihan, M. J.; Humble, S. Nucl. Phys., B; 81: No. 1, 61-69(25 Oct 1974).

Data are presented on the reactions $K^-p \rightarrow \Delta^{++}$ + anything at 10 and 16 GeV/c and $\pi^-p \rightarrow \Delta^{++}$ + anything at 16 GeV/c. In the K^-p reaction, scaling is observed between 10 and 16 GeV/c in the variable M^2/s. The scaling occurs at relatively low values of M in marked contrast to the reaction $\pi^+p \rightarrow \Delta^{++}$ + anything. This result can be explained by duality arguments on a triple Regge picture, since the exchanged reggeon-incident particle scattering is exotic. Comparison of the π^-p reaction, which is similarly exotic, with the K^-p reaction at the same energy gives further evidence for factorization in pomeron-dominated inclusive reactions. (auth)

9893 RHO-ω INTERFERENCE IN $\pi^-p \rightarrow \pi^-\pi^+n$ AT 17.2 GeV. Estabrooks, P.; Hyams, B.; Jones, C.; Martin, A. D.; Weilhammer, P. (European Organization for Nuclear Research, Geneva (Switzerland)); Blum, W.; Dietl, H.; Grayer, G.; Koch, W.; Lorenz, E. Nucl. Phys., B; 81: No. 1, 70-83(25 Oct 1974).

Results are presented of a study of ρ-ω interference effects in high statistics, good resolution, $\pi^-p \rightarrow \pi^+\pi^-n$ data obtained at 17.2 GeV using the CERN-Munich spectrometer. The t-dependence of ρ-ω interference is investigated in the various $\pi\pi$ production amplitudes. While effects are observed in all the P-wave production amplitudes, the most pronounced structure occurs in the natural parity exchange amplitude in the t interval $0.1 \leq -t \leq 0.4$ GeV^2. Under certain assumptions the relative magnitudes and phases of the ρ- and ω-production amplitudes are determined as functions of t. (auth)

9894 A CALCULATION OF THE [1,1] PADE APPROXIMANT FOR PION-NUCLEON PHASE-SHIFTS. Saxena, R. P. (Goeteborg Univ. (Sweden). Institutionen foer Teoretisk Fysik); Schwela, D. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). Nucl. Phys., B; 81: No. 1, 179-188(25 Oct 1974).

Low energy pion-nucleon phase shifts were computed using, once subtracted fixed hyperbola dispersion relations and elastic unitarity, in the {1,1} pade approximation. A t-channel s-wave pole (σ-meson) was introduced, the residue of which is determined from Adler's self-consistency condition. It is found that although the inclusion of the Adler condition gives results which are considerably closer to experimental phase shifts as compared to earlier calculations of this kind with fixed momentum transfer dispersion relations, the agreement with data is still far from satisfactory. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 10121.

9895 (RL-74-140) COLLISION BROADENING OF RESONANCES. Bugg, D. V. (Science Research Council, Chilton (UK). Rutherford Lab.). Sep 1974. 61p. Dep. NTIS (US Sales Only) $6.25.

The lifetime of a particle resonance, such as an N*, propagating through a nucleus or in the vicinity of a "spectator" nucleon is reduced by collisions, and consequently the width of the resonance is increased. This phenomenon is the nuclear analog of collision broadening, well known in atomic spectroscopy. It explains quantitatively the discrepancy between the πd total cross section in the resonance region and Glauber theory, a discrepancy previously ascribed to variation with energy of the parameter $\langle r^{-2}\rangle$. A simple rule is given for the energy of πd resonances relative to πN. The same arguments applied to Kd total cross sections indicate that the $\bar{K}N$ branching ratios of Y* resonances should be systematically increased over previously quoted results. It is shown how the channel $\pi d \rightarrow NN$ is related to Glauber theory, and an anomalous result obtained by Beder for the πd scattering length is explained away. A general rule for the shape of the N*(1230) in light nuclei is proposed, namely that the product (width × height) of the resonance should be the same as for free πN collisions. Collision broadening also explains the observation that resonance widths increase with the momentum transfer, $-t$, at which the resonance is produced; the reaction $\pi^-p \rightarrow \rho^0n$ is treated quantitatively as an example. The broadening of ρ mesons photoproduced in nuclei is also mentioned. Large collision broadening offers an explanation of the observation that the total cross section of A_1 mesons in nuclei is close to that of pions, and offers fresh insight into the phenomenon of diffraction dissociation. (auth)

9896 ANGULAR MOMENTUM ANALYSIS OF THE FOUR–NUCLEON GREEN'S FUNCTION. Bessis, D.; Mery, P.; Turchetti, G. (Servide de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, BP. No. 2–91190, Gif–sur–Yvette, France). Phys. Rev. D 10: No. 6, 1992-2009 (15 Sept 1974).

A formalism for a complete partial–wave expansion of the four–nucleon Green's function is given by generalizing a standard method. All of the constraints imposed by the symmetry properties (parity, time reversal, and exchange symmetry) are worked out, and an extended unitarity condition is shown to be satisfied. The use of Padé approximations to the Green's function is shown to provide a physical amplitude which is unitary, has correct threshold behavior in all waves, and has good analyticity properties. Therefore, such a scheme is well suited to explore beyond the Born term the dynamical content of various Lagrangian models proposed for the nucleon–nucleon interaction. (auth)

9897 KOBA–NIELSEN–OLESEN SCALING HYPOTHESIS AND THE TOTAL MULTIPLICITY DISTRIBUTION FOR PRODUCED HADRONS IN HIGH–ENERGY p p COLLISIONS. Slattery, P. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 10: No. 7, 2304-2309 (1 Oct 1974).

The observed high–energy scaling behavior of the charged–particle multiplicity distribution in p p collisions is shown to be consistent with the hypothesis that the total multiplicity distribution for all the produced hadrons satisfies the KNO scaling prediction at present energies. This hypothesis, plus simple, experimentally valid assumptions concerning leading–particle effects and neutral– to charged–particle correlations, is found to yield the measured multiplicity characteristics of particle production in high–energy p p collisions. (auth)

9898 TEST OF A GENERALIZED CHOU–YANG MODEL AT CURRENTLY AVAILABLE HIGH ENERGIES. Hayot, F.; Sukhatme, U.P. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 10: No. 7, 2183-2185 (1 Oct 1974).

The Chou–Yang model generalized to include energy dependence is shown to give a very good description of the CERN ISR pp data. We show that in this type of model the height of the secondary maximum increases by roughly a factor of 2 over the ISR range. This feature, which can be experimentally checked, will distinguish models of this type from the usual Regge models where such an increase in bump height is not expected. (auth)

9899 CHARGE CORRELATION BETWEEN TWO PIONS IN A STATISTICAL CHARGE DISTRIBUTION AMONG HADRONS. Chao, A.W.; Yang, C.N. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11790). Phys. Rev. D 10: No. 7, 2119-2123 (1 Oct 1974).

The results, both mathematical and physical, of an earlier paper are generalized to charge correlations between two pions. (auth)

9900 EVALUATION OF THE POMERON-POMERON CUT IN GRIBOV REGGEON CALCULUS FROM INCLUSIVE DATA. Capella, A. (Paris-11 Univ., 91–Orsay (France). Lab. de Physique Theorique et Particules Elementaires); Kaplan, J. (Paris-11 Univ., 91–Orsay (France). Lab. de Physique Theorique et Hautes Energies). Nucl. Phys., B; 79: No. 1, 141-152(11 Sep 1974).

It is shown that the two-pomeron cut in Gribov reggeon calculus can be computed from the same PPP and PPR couplings appearing in the one-particle inclusive spectra. This cut is computed using the values of those couplings determined from inclusive data — allowing for large uncertainties in order to determine the maximum size of the cut compatible with the present data. This size depends in a crucial way on the behavior of the PPP couplings near $t = 0$. For any reasonable type of behavior the cut turns out to be much too small to account for the rise of the proton-proton total cross section in the ISR energy range. (auth)

9901 MATRIX PADÉ APPROXIMANTS OF THE NUCLEON–NUCLEON INTERACTION. Gersten, A.; Solow, Z. (Department of Physics, University of the Negev, Beer–Sheva, Isreal). Phys. Rev. D 10: No. 3, 1031-1042 (1 Aug 1974).

The matrix Padé approximants (with 16×16 matrices) and the scalar Padé approximants (with 4×4 matrices) of the nucleon–nucleon S–matrix elements are calculated for total angular momentum $J \leq 4$ and for laboratory kinetic energy up to 425 MeV. The calculations are based on one– and two–pion exchanges of the pseudoscalar interaction. The coupling constant g is the only parameter of the interaction for which a value, consistent with experimental results, $g^2/4\pi = 15$ is assumed. A simplified calculational scheme and formalism are presented. In order to interpret the results properly we give estimates in which energy regions we expect the one– and two–pion exchanges to be significant. For these energy regions we found that the matrix Padé approximants describe quite well the nucleon–nucleon interaction and give better approximations to the experimental data as compared to other methods of unitarization. The fact that in the framework of quantum field theory it is possible, even in limited energy regions, to give a reasonable description of the nucleon–nucleon scattering gives us more confidence in the pseudoscalar interaction as the fundamental interaction of nucleons and pions. (auth)

9902 MULTIPLICITY DISTRIBUTION AND MESON INTERACTION. Hoang, T.F. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 10: No. 3, 1043-1047 (1 Aug 1974).

The multiplicity distributions from high–energy pp collisions are analyzed using a Poisson–type distribution which has two input parameters expressed in terms of the measures of the average multiplicity and the width parameter. A discussion is presented on its statistical and physical properties, as well as the mechanism of meson interaction in analogy with the photon statistics due to Scully and Lamb. (auth)

9903 NEW SCALING VARIABLE AND EARLY SCALING IN SINGLE–PARTICLE INCLUSIVE DISTRIBUTIONS FOR HADRON–HADRON COLLISIONS. Yen, E. (Department of Physics, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. D 10: No. 3, 836-843 (1 Aug 1974).

We suggest that the invariant cross section for $a + b \to c + X$ should be plotted in terms of $(\tilde{x}, P_\perp)$, where $\tilde{x} = 2E^*/\sqrt{s}$ and E^* is the energy of particle c in the center–of–mass system. We have shown for processes with exotic $ab\bar{c}$ [such as $p + p \to (\pi^+, K^+, \bar{p}) + X$] that the invariant cross sections $E\, d^3\sigma/d^3p \to f(\tilde{x}, P_\perp)$ at $P_\perp = 0.2$, 0.4, and 0.8 GeV/c over an energy range of $P_{inc} = 12-1500$ GeV/c. Furthermore, scaling in terms of $(\tilde{x}, P_\perp)$ provides a natural connection between the small–$P_\perp$ and large–$P_\perp$ regions. Predictions on the single–particle distribution when both $P_{\parallel}^*$ and $P_\perp^*$ are large are also presented. (auth)

9904 SPECTATOR ISOBARS IN DEUTERON COLLISIONS. Nath, N.R. (Mary Washington College, Fredericksburg, Virginia 22901); Kabir, P.K.; Weber, H.J. Phys. Rev. D 10: No. 3, 811-815 (1 Aug 1974).

Estimates are made for the production of spectator isobars in collisions with deuterons. The crucial question, if this is to be used to deduce the isobar content of the deuteron, is whether one can distinguish an isobar "created" in the collision from one which "preexisted" in the deuteron and was shaken loose as a spectator. We examine an important source of such created isobars and show how these are distributed differently from the spectator isobars. The argument is illustrated by considering the explicit example of Δ^- production in dp collisions. (auth)

9905 GLAUBER–DECK MODEL FOR 3π PRODUCTION ON NUCLEI. Cutler, R.T. (Department of Physics, University of Illinois, Urbana, Illinois 61801). Phys. Rev. D 10: No. 3, 824-835 (1 Aug 1974).

A Glauber theory is developed for the reaction $\pi^- A \to \pi^+\pi^-\pi^- A$, where A is a nucleus, using a Reggeized Deck amplitude for 3π production on a nucleon. A simple absorption amplitude for the 3π system is used in which the pions are assumed not to interact. The resulting amplitude is calculated for carbon at 15.1 GeV/c, using a Monte Carlo approach. An alternative absorption scheme is discussed, and a multi–impact–parameter model proposed. The multi–impact–parameter model is found to result in cross sections practically identical to computationally simpler models. The reaction $\pi^- C \to \pi^+\pi^-\pi^- C_{4.44}^*$ is also calculated using an effective one–particle excitation parametrization, and the results are compared to experimental data at 6 GeV/c. (auth)

9906 PROTON–PROTON SCATTERING AND THE POMERON. Collins, P. D. B.; Gault, F. D.; Martin, A. (Durham Univ. (UK)). Nucl. Phys., B; 80: No. 1, 135-163(4 Oct 1974).

Various attempts to fit the data on pp and $\bar{p}p$ elastic scattering and total cross sections, including the recent ISR data, are described with a variety of Regge pole and cut models. Only two types of models are able to explain the data over the whole energy range satisfactorily. The simplest of these has no cuts, but a pomeron pole with trajectory $\alpha_p(0) = 1.06 + 0.25\,t$, and a non-shrinking "core" term at large $|t|$. The other has a flat trajectory, $\alpha_p(t) = 1.06$ for all t, and strong eikonal-model cuts which explain both the shrinkage at low $|t|$, and the lack of it at larger $|t|$. Various speculations which relate the fact that $\alpha_p(0) > 1$ to the small triple-pomeron coupling are also briefly reviewed. (auth)

9907 DETERMINATION OF THE ONE-PION EXCHANGE POTENTIAL FROM pn AND $\bar{p}p$ CHARGE EXCHANGE SCATTERING. Bongardt, K.; Pilkuhn, H.; Schlaile, H. G. (Karlsruhe Univ. (TH) (F. R. Germany)). Phys. Lett., B; 52: No. 3, 271-274 (14 Oct 1974).

The πNN vertex function is determined from $d\sigma/dt$ for $pn \to np$ and $\bar{p}p \to \bar{n}n$ at 8 GeV/c in the interval $0 < -t < 0.1$ GeV^2. A "regulator mass" of $3.5m_\pi = 488$ MeV is found, corresponding to an "extension" of 0.40 fm of the πNN vertex. The resulting OPE potential is discussed. (auth)

9908 TWO COMPONENT ANALYSIS OF THE INELASTIC OVERLAP FUNCTION. Inami, T.; Phillips, R. J. N.; Roberts, R. G. (Science Research Council, Chilton (UK). Rutherford Lab.). Phys. Lett., B; 52: No. 3, 355-359(14 Oct 1974).

ISR pp elastic data are analyzed, and it is shown that much of the structure of the inelastic overlap function can be attributed to absorptive effects. The "unabsorbed" function can be expressed as the sum of two exponentials (or two Gaussians in b-space) whose behaviors suggest they correspond to the diffractive and multiperipheral components of inelastic scattering. Although the net increase in cross section is peripheral, the diffractive component is essentially central. (auth)

9909 TRIPLE REGGE AND FINITE MASS SUM RULE ANALYSIS OF THE INCLUSIVE REACTION $pp \to pX$. Field, R. D.; Fox, G. C. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 80: No. 3, 367-402(18 Oct 1974).

The results of a comprehensive analysis of inclusive $pp \to pX$ data in terms of the triple Regge formalism are presented. All available data are used and in the theory include PPP, PPR, RRP, RRR, $\pi\pi P$, and $\pi\pi R$ terms. Further the importance of interference terms (e.g. PRP) are examined and solutions with the triple pomeron either vanishing or nonvanishing at $t = 0$ are presented. Predictions are made for both $pp \to pX$ and $pn \to pX$ at NAL and ISR energies. In addition, finite mass sum rules (FMSR), constructed from low mass diffractive dissociation data, are shown to be in good agreement with the high energy, high mass fits. The energy, momentum transfer and moment dependence of the FMSR are discussed in detail. (auth)

9910 PION-DEUTERON SCATTERING LENGTHS VIA FADDEEV. Myhrer, F. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). Nucl. Phys., B; 80: No. 3, 491-498(18 Oct 1974).

The dependence of the pion-deuteron scattering length on variations in the pion-nucleon amplitudes are studied. It is found that the πd scattering length depends moderately on the range of the πN forces and that it remains sensitive to the variation in the πN isoscalar scattering length. (auth)

9911 ISOSPIN ANALYSIS OF THE REACTIONS pp → N(Nπ) AT 12 AND 24 GeV/c. Boeckmann, K.; Heilmann, H. G.; Idschok, U.; Kobe, P.; Selonke, F. (Bonn Univ. (F. R. Germany). Physikalisches Inst.); Blobel, V.; Fesefeldt, H.; Hellwig, B.; Moenkemeyer, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Franz, H. Nucl. Phys., B; 81: No. 1, 45-60 (25 Oct 1974).

The reaction pp → nucleon + nucleon + pion at 12 and 24 GeV/c is analyzed in terms of the isospin amplitudes for the production of the (Nπ) system. The energy dependence of the $I(N\pi) = \frac{1}{2}$ amplitude is weak, while the $I(N\pi) = \frac{3}{2}$ contribution shows the strong energy dependence known from meson exchange reactions. The slope parameter B of the $d\sigma/dt'$ distributions of the $I(N\pi) = \frac{1}{2}$ contribution is a strong function of the (Nπ) mass, decreasing sharply from about 12 GeV^{-2} at threshold to about 4 GeV^{-2} above 1700 MeV. Comparing the results for the $I(N\pi) = \frac{1}{2}$ cross section with those of similar investigations in πp and Kp reactions, it is found that factorization is valid within experimental errors. The results support the conclusion that the $I(N\pi) = \frac{1}{2}$ contribution is dominated by diffraction dissociation of the proton. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 9798.

9912 NONLINEAR GROUP REALIZATION INVOLVING 2—DIMENSIONAL SPACE—TIME SYMMETRY. Machacek, M.E.; McCliment, E.R. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). Phys. Rev. D 10: No. 6, 1962-1970 (15 Sept 1974).

The nonlinear—group—realization methods of Coleman, Wess, and Zumino are extended to include the effect of space—time symmetry in a simple 2—dimensional model. A coset decomposition of the 4—dimensional Lorentz group is made with respect to the subgroup generated by a Lorentz boost and one internal rotation. Nonlinear Goldstone fields are identified with the coset parameters in this decomposition. The physical properties of these fields are determined by the subgroup. Charge pairs ± q are found which are not scalars under the Lorentz boost. Physical momentum and energy operators are introduced. Covariant derivatives are then calculated and the phenomenological Lagrangian is discussed. (auth)

9913 MESON COUPLINGS FROM CONSERVED VECTOR CURRENT AND PARTIALLY CONSERVED AXIAL—VECTOR CURRENT. Weihofen, W.H. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. D 10: No. 6, 1970-1980 (15 Sept 1974).

By requiring only that conserved vector current (CVC) and partially conserved axial—vector current (PCAC) be expressed by the field equations, a matrix formalism is developed for the nonlinear meson Lagrangian density, incorporating both conditions in any group representation. The pseudoscalar—meson "mass term" is given explicitly. The concept of the chiral covariant derivative is employed to treat a general system of vector, axial—vector, and pseudoscalar mesons in an elegant manner. In the context of invariant pseudoscalar—meson coupling constant $f(\simeq 0.7 m_\pi^{-1}$?) and vector—meson coupling constant g ($\simeq 6$) there follows immediately a relation between the (unrenormalized) axial—vector and vector—meson masses: $m_A^2 = m_V^2 + (g/2f)^2$. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 9758, 9796, 9797, 9799, 10079, and 10080.

9914 SU(6) BREAKING IN A RELATIVISTIC QUARK MODEL. Kellett, B.H. (Department of Natural Philosophy, University of Glasgow, Glasgow, G12 8QQ, Scotland). Phys. Rev. D 10: No. 7, 2269-2279 (1 Oct 1974).

Consideration of the relativistic motion of quarks within a composite baryon is shown to lead to an unambiguous procedure for calculating SU(6) —breaking effects. Matrix elements of the weak and electromagnetic currents between low—lying baryon states are calculated. The symmetry breaking is appreciable, and for neutron β decay, $g_A/g_V = -1.265$ for $m_{\text{quark}} = 300$ MeV. Small deviations from the conserved—vector—current hypothesis are calculated, and the symmetry breaking induces small second—class current terms between physical states. These weak form factors are in agreement with the available data. Symmetry breaking of the correct order of magnitude is predicted for the magnetic moments of the baryon octet, but the agreement with experiment is not as good in this case. (auth)

9915 NEUTRAL—CURRENT EFFECTS IN ELASTIC ELECTRON—NUCLEON SCATTERING. Reya, E.; Schilcher, K. (Institut für Physik, Universität Mainz, 6500 Mainz, West Germany). Phys. Rev. D 10: No. 3, 952-959 (1 Aug 1974).

Parity—violating effects are studied in considerable detail for elastic electron—nucleon scattering. Based on a unified Weinberg gauge model properly generalized to include nonstrange hadrons, we derive and discuss corrections to the Rosenbluth formula, and left—right asymmetries of longitudinally polarized electrons as well as nucleons. Any dependence of electron—nucleon scattering on the longitudinal polarization would be evidence of parity violation. The size of such neutral—current effects in general differs from that naively expected on purely dimensional grounds and strongly depends on the nucleon target used. (auth)

9916 CABIBBO'S MODEL WITH FIRST—ORDER SU_3—BREAKING CORRECTIONS AND HYPERON β DECAY. Garcia, A. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 10: No. 3, 884-890 (1 Aug 1974).

We consider first—order symmetry—breaking corrections to Cabibbo's model and compare with available data in baryon semileptonic decays. The data seem to indicate that higher—order corrections are required, or else that second—class currents are present. (auth)

Applications (Strong)

Refer also to abstracts 9882 and 10130.

9917 EFFECT OF INTERNAL SYMMETRY ON HADRONIC BINDING FORCES. Capps, R.H. (Physics Department, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 10: No. 2, 652-657 (15 July 1974).

The possibility of molecular—type binding in a many—multiplet quark model is considered. This is defined as the binding of three or more constituents (quarks and antiquarks) that results from a spatial configuration in which attracting pairs of particles are relatively close together. It is shown that the strength of such forces is a decreasing function of the size of the regular representation of the assumed internal—symmetry group. It is suggested that the actual hadronic internal symmetry may be the simplest symmetry that does not lead to many bound states of many hadrons. (auth)

9918 PHENOMENOLOGICAL APPROACH TO CHIRAL—SYMMETRY BREAKING. Scadron, M.D. (Brookhaven National Laboratory, Upton, New York 11973); Jones, H.F. Phys. Rev. D 10: No. 3, 967-977 (1 Aug 1974).

It is shown that all meson—baryon and meson—meson σ terms which can be extracted from experiment are in fact consistent with the $(3, \bar{3})$ chiral—symmetry—breaking scheme, $H' = u_0 + cu_8$, provided that c assumes the value $c \sim -1.0$. (auth)

Scattering Theory

Refer also to abstracts 9833, 9835, 9836, 9841, 9889, 9896, 10107, and 10204.

9919 (JINR-P2-8090) THREE-REGGEON RESCATTERING IN ϕ^2-THEORY. Gershkevich, M. V.; Efremov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Using α-parameter method it is shown, that nonplanar diagrams imitating three-region exchange have the cut in j-plane at the point $j = n\alpha(t/n^2) - n + 1$ with $n = 3$. It is shown that this rule is valid for any n. (auth)

9920 (ORO-4317-44) EQUIVALENCE BETWEEN TIME-DEPENDENT AND TIME-INDEPENDENT FORMULATIONS OF TIME DELAY. Technical Report No. 75-032. Bolle, D.; Osborn, T. A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Nov 1974. 15p. Dep. NTIS $4.00.

The time-dependent and time-independent treatments of time delay in two body scattering are discussed and shown to be completely equivalent. It is also proved that no oscillating terms occur if the time delay operator is evaluated between smooth wave packets. As a further result, some mathematical assumptions, used to derive the relation between time delay and the S-matrix in the time-dependent method, can be discarded. (auth)

9921 (RL-74-118) DIFFRACTIVE SCATTERING IN THE DUAL MODEL. Chan, H. M.; Paton, J. E.; Tsou, S. T. (Science Research Council, Chilton (UK). Rutherford Lab.). Aug 1974. 81p. Dep. NTIS (US Sales Only) $7.25.

A method is suggested for calculating the elastic amplitude as the shadow of multiparticle processes. This does not require explicit formulas for the production amplitudes, but depends only on the following assumptions: Regge behaviour, semi-local duality, and exchange degeneracy. The system is multiperipheral in general structure but because of the given assumptions, it incorporates such features as the clustering of final particles and provides a proper treatment of quantum numbers, phases, and resonance spins. As a result, the unitarity sum separates automatically into two components corresponding respectively to Pomeron and ordinary Reggeon exchange, each of which is seen to have the correct qualitative dependence on the quantum numbers, the energy s, and the momentum transfer t. Quantitatively, the elastic amplitude is given in terms of a triple-Regge vertex, for which a simple parametrization is suggested based on a detailed study of existing experiment and the Veneziano model. The method is then applied to calculate the elastic amplitudes for $\pi^{\pm}$p, $K^{\pm}$p and pp within the range $6 < s < 50$ and $0 > t > -.5$ GeV^2. Semi-quantitative agreement is obtained with experiment with essentially no free parameter. Although the investigation is restricted at present to elastic scattering as shadow of only the nondiffractive component satisfying the given assumptions, the method is believed to apply also to other diffractive processes, and may be regarded as the first step in an iterative solution of the full unitarity equation. (auth)

9922 POLES OF THE S MATRIX FOR A COMPLEX SURFACE DELTA FUNCTION POTENTIAL. Romo, W. J. (Carleton Univ., Ottawa). Can. J. Phys.; 52: No. 17, 1603-1614(1 Sep 1974).

The resonance properties of the potential $V(r) = v\delta(r-R)$ are investigated for both real and complex values of v (absorptive potentials). The poles of the s wave S matrix are given and the persistence of a resonance with increasing absorption is discussed. (auth)

9923 PROOF OF THE READING–BASSICHIS CONJECTURE IN HIGH–ENERGY POTENTIAL SCATTERING AT BACKWARD ANGLES. Wu, A.C.T. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 10: No. 7, 2248-2250 (1 Oct 1974).

A proof is given for the Reading–Bassichis conjecture in the Nth–order Born approximation for high–energy potential scattering at backward angles. The conjecture states that under the stationary–phase approximation the hard scattering acts in such a way that "the radius vector bisects the angle through which the particle is scattered." (auth)

9924 GENERALIZED EIKONAL FUNCTIONS IN POTENTIAL THEORY. Fried, H.M. (Physics Department, Brown University, Providence, Rhode Island 02912); Hahn, Y. Phys. Rev. D 10: No. 6, 1908-1917 (15 Sept 1974).

A potential–theory formalism is described within which exponentialized corrections to simple Glauber theory may be developed. An alternate formalism with direct generalization to relativistic field theory is developed for potential scattering at all angles, and some numerical work is presented to confirm and justify the approximations employed. (auth)

9925 INVERSE PROBLEM OF SCATTERING AND OFF–SHELL CONTINUATION OF THE TRANSITION AMPLITUDE. Karlsson, B.R. (Institute of Theoretical Physics, Fack, S–402 20 Göteborg 5, Sweden). Phys. Rev. D 10: No. 6, 1985-1991 (15 Sept 1974).

It is shown how dispersion relations for the Jost solution can be used to generate a class of integral equations, among them the Marchenko equation, that all solve the inverse problem for the s–wave Schrödinger equation. Motivated by the fact that scattering data (the phase shifts) are functions of momentum, we develop momentum–space versions of some of these equations. We also construct a Fredholm series solution to the inverse problem; it is formulated entirely in momentum space, and is convergent for a large class of potentials with or without bound states. As a by–product we obtain simple procedures for the continuation of the physical transition amplitude off the energy shell. (auth)

9926 POMERANCHUK SINGULARITY IN A CLASS OF REGGEON FIELD THEORIES SUGGESTED BY DIRECT–CHANNEL UNITARITY. Abarbanel, H.D.I. (California Institute of Technology, Pasadena, California 91109); Bartels, J.; Dash, J.W. Phys. Rev. D 10: No. 6, 1939-1945 (15 Sept 1974).

Within the context of a generalized Reggeon calculus we study the infrared ($J \to 1$, $t \to 0$) limit of a class of models whose "bare" structure arises from elastic amplitudes of the form $A(s, t) = s(\ln s)^{\nu} J_{\nu}(a\sqrt{-t\ln s})$. Such amplitudes are suggested by the implementation of s–channel unitarity via eikonalization of a "Born term," via absorption models, and via the multiperipheral bootstrap. We employ the renormalization group to study the renormalized Pomeranchuk singularity when the interaction involves a triple coupling. Our major result is that for $\nu = 0$ these theories are infrared–free. The total cross section behaves as $\sigma_T(s) \sim \gamma_1 - \gamma_2/[(\ln s)(\ln\ln s)^{1/2}]$ where γ_1 factorizes. Scaling laws for the Reggeon proper vertex functions are given. (auth)

9927 HARMONIC INVERSION AND RECIPROCITY RELATIONS OF DEEP INELASTIC STRUCTURE FUNCTIONS. Caiazza, G. C. (Naples Univ. (Italy). Istituto di Fisica); Etim, E. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Phys. Lett., B; 51: No. 5, 457-460(2 Sep 1974).

A new derivation is given of the reciprocity relations between deep inelastic structure functions based on a representation of the transformation by reciprocal radii as an integral transform in the space of harmonic functions. A simple picture, consistent with our intuition of short-distance operator product expansion, is suggested. (auth)

9928 TIME DELAY AND THE FEW-BODY PROBLEM. Osborn, T. A. (Brooklyn Coll., N. Y. (USA)); Bolle, D. (Louvain Univ. (Belgium). Inst. for Theoretical Physics). Phys. Lett., B; 52: No. 1, 13-16(16 Sep 1974).

This letter gives a solution of the few-body time-delay problem. By using the time-dependent theory of scattering, a rigorous abstract time-delay operator is defined. The matrix elements of this operator are evaluated in terms of on-shell S-matrices and their energy derivatives. (auth)

9929 ROTATIONAL ANALYTICITY OF THE S MATRIX. Dragt, A.J.; Sterman, G.F. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 10: No. 2, 663-674 (15 July 1974).

Starting from known results of field theory, it is shown that both scattering and production amplitudes are analytic functions on the group SU(2). This analyticity is then used to simplify the derivation of high–energy bounds for scattering amplitudes of particles with spin. The origin of kinematic singularities as the result of parametrization of an analytic manifold is seen to be particularly transparent when the manifold is chosen to be SU(2). Field theory is used to show that production amplitudes are analytic in an SU(2) domain analogous to the Lehmann ellipse for scattering amplitudes. Finally, unitarity is used to demonstrate that production amplitudes, when smeared over a small region of outgoing phase space, are SU(2) analytic in a larger domain analogous to the Martin ellipse. (auth)

9930 CROSSING SYMMETRY AND COHERENT STATES. Peccei, R.D. (Theory Division, Rutherford High Energy Laboratory, Chilton, Didcot, Berkshire, England). Phys. Rev. D 10: No. 2, 759-761 (15 July 1974).

We show, on general grounds, that the connected T operator can be written in a diagonal form in a coherent–state representation. Such an expression automatically yields crossing–symmetric n–particle matrix elements. We use this technique to establish a connection between dual resonance models and field theory. (auth)

9931 RELATIVISTIC TRANSITION AMPLITUDES IN CLASS OF O(4, 2) INFINITE MULTIPLETS. I. CONTINUUM–CONTINUUM TRANSITIONS. Barut, A.O.; Rasmussen, W.; Salamó, S. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 10: No. 2, 622-630 (15 July 1974).

A class of unitary irreducible O(4, 2) representations characterized by the lowest spin μ, $\mu = 0, \pm 1/2, \pm 1, \ldots$, and the corresponding infinite–component wave equations are considered. The continuum–continuum transition amplitudes are evaluated by the method of analytic continuation generalizing the relativistic Coulomb case ($\mu = 0$). A general exact Regge–type amplitude is derived, which contains the relativistic scattering amplitudes of O(4) –symmetric Coulomb interactions of two dyons in the symmetric model and amplitudes in certain hadron models as special cases. (auth)

9932 FACTORIZABILITY OF RESONANCE POLES IN MULTIPARTICLE AMPLITUDES. Smith, J.D. (University of Leeds, Leeds, England). J. Math. Phys. (N.Y.) 15: No. 11, 1859-1865 (Nov 1974).

Using the energy–analytic representation of Green's functions and relying on certain explicitly stated properties of the off–shell scattering elements, it is shown that resonance poles in the S matrix contribute poles to the off–shell scattering amplitude, and the residues there have the same factorizable form as that associated with bound state particles. (auth)

9933 UNITARITY AND CROSSING IN REGGEON–PARTICLE AMPLITUDES. Hoyer, P. (State University of New York, Stony Brook, New York 11790); Trueman, T.L. Phys. Rev. D 10: No. 3, 921-932 (1 Aug 1974).

We discuss the single Regge limit of the process $a+b \to c+d+e$, in which the five–point amplitude is proportional to the Reggeon–particle amplitude $a+R \to c+d$. The partial–wave expansion in the cd system is given in the general case when all external particles have spin. Using this expansion we show that unitarity requires the phase of the

Reggeon—particle amplitude to be the same as the phase of the amplitude for c+d → c+d in the elastic region. This implies relations between observable density matrix elements. We discuss the predictions for several physical reactions. We investigate the question of crossing for Reggeon—particle amplitudes by deriving the connection between the s—channel and t—channel helicity amplitudes. The helicity crossing matrix turns out to be the ordinary spin rotation matrix, the Reggeon being treated as a particle of continuous spin α_R. (auth)

9934 CASTILLEJO—DALITZ—DYSON ZEROS IN THE POMERANCHUKON SCATTERING AMPLITUDE. White, A.R. (National Accelerator Laboratory, Batavia, Illinois 60510); Kang, K. Phys. Rev. D 10: No. 3, 983-987 (1 Aug 1974).

Using dispersion relations and the properties of Herglotz functions we study solutions of two—Pomeranchukon unitarity in the presence of Castillejo—Dalitz—Dyson (CDD) zeros. We conclude that the best solution is that in which two CDD zeros are present and the triple—Pomeranchukon vertex vanishes linearly. This struture leads to the factorization of cross sections to $0(1/(\ln s)^2)$. (auth)

9935 DIVERGENT INTEGRALS IN SCATTERING THEORY. Huby, R. (Univ. of Liverpool). pp 326-332 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

A range of scattering problems recently studied in which divergent integrals have appeared is described. It is shown that certain divergent integrals have arisen from what are apparently two different kinds of origin, viz. three-body channels on the one hand and the treatment of resonances on the other, but both of these have coalesced in some calculations of deuteron stripping to unbound levels. (MHR)

9936 ZEROS IN POMERON AMPLITUDES. Cardy, J. L. (Science Research Council, Daresbury (UK). Daresbury Lab.). Nucl. Phys., B; 79: No. 2, 317-332(18 Sep 1974).

It is shown how, in the weak coupling solution of the reggeon calculus, pomeron amplitudes acquire zeros when all the pomerons have zero mass, in a manner similar to that of the triple-pomeron coupling. This latter zero is found to have a trajectory away from $t = 0$ equal to that of the two-pomeron cut. The weak coupling solution is shown to be equivalent to the theory being asymptotically free in the infrared region. (auth)

9937 CLUSTERS, CORRELATIONS AND TRANSVERSE MOMENTA. Hayot, F.; Henyey, F. S.; Lebellac, M. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). Nucl. Phys., B; 80: No. 1, 77-89(4 Oct 1974).

The short-range part of two-particle correlations is discussed as it results from the phase space available in cluster decay. In such an approach, certain variables emerge which should be useful to organize the data and extract interesting information. In particular, tests of large transverse motion of clusters are considered. (auth)

9938 RELATIVISTIC COULOMB SCATTERING WITHOUT REGULARIZATION. Marques, G. C.; Papanicolaou, N. (New York Univ., N. Y. (USA). Dept. of Physics). Nucl. Phys., B; 80: No. 2, 247-268(11 Oct 1974).

Asymptotic forms of Green functions for relativistic Coulomb scattering are constructed, and the infrared singularity structure is identified to all orders in the potential. Zwanziger's reduction formulas for scalar and spin-½ particles are proven to be finite to all orders. The question of the definition of the S-operator and the related difficulties of the forward direction singularity are explicitly discussed, and the unitarity is proven on the basis of the asymptotic solutions and second-order calculations. (auth)

9939 UNITARY REPRESENTATIONS OF SUPER-GAUGE SYMMETRIES. Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 80: No. 3, 499-505(18 Oct 1974).

A method is given for constructing some of the unitary irreducible representations of the Wess—Zumino super-gauge symmetry. Application of this symmetry to the analysis of S-matrix elements is considered. A new super-gauge symmetry which includes isospin is introduced, and some of its representations are constructed. (auth)

9940 PERIPHERAL THRESHOLDS AND REGGE ASYMPTOTIC EXPANSIONS. Chew, G. F.; Koplik, J. (California Univ., Berkeley (USA). Dept. of Physics). Nucl. Phys., B; 81: No. 1, 93-117(25 Oct 1974).

Multiperipheral models are used to show how the Regge expansion, while lacking threshold branch points, may nevertheless approximate the localized physical effects of "peripheral" thresholds. Examples are given to demonstrate that a single pair of complex poles is capable of representing even the lowest inelastic thresholds in both total and single-particle inclusive cross sections. The Regge mechanism that allows the position of a threshold to depend sensibly on the masses of incoming and outgoing particles is elucidated. (auth)

9941 UNITARITY AND THE ENERGY AVERAGED S-MATRIX. Simonius, M. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Kernphysik). Phys. Lett., B; 52: No. 3, 279-281(14 Oct 1974).

A unitarity relation among mean width $\overline{\Gamma}$, level distance D and the absorptive part of the energy averaged S-matrix is proved and discussed. Consequences for the determination of $\overline{\Gamma}/D$ are pointed out. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 9961.

9942 THEORY OF BOSE QUANTUM CRYSTALS. Dzyaloshinskii, I. E.; Kondratenko, P. S. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 3, 1195-1209(Sep 1974). (In Russian).

A theory of crystals consisting of Bose particles of a single type (e.g. ^{4}He) is developed by quantum theory methods. Collective excitation spectra are determined and a number of exact relations between the normal and superfluid densities are derived on the assumption that single-particle excitations in such crystals form a Bose condensate. (auth)

9943 PRINCIPLE OF COMPENSATION OF DANGEROUS DIAGRAMS FOR BOSON SYSTEMS. III. FINITE TEMPERATURE. Kobe, D.H.; Goble, G.W. (Department of Physics, North Texas State University, Denton, Texas 76203). J. Math. Phys. (N.Y.) 15: No. 11, 1835-1844 (Nov 1974).

The principle of compensation of dangerous diagrams (PCDD) is derived at finite temperature for boson systems by minimizing the average number of Bogoliubov quasiparticles in the system. The conditions obtained state that (a) the amplitude for the creation (or annihilation) of a single quasiparticle is zero and (b) the amplitude for the creation (or annihilation) of a pair of quasiparticles is zero. These conditions are expanded in finite—temperature perturbation theory, using both the density matrix and Green's function methods. In first order the resulting equations are the Hartree—Fock—Bogoliubov equations for a homogeneous boson system at finite temperature which can also be obtained from a free energy variational principle. (auth)

9944 ASPECTS OF CONDENSATION IN ^{4}He II. Cummings, F. W. (Univ. of California, Riverside). pp 108-116 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

Certain aspects of the theoretical problem of ^{4}He II, liquid helium below the lambda transition $T = T_\lambda \cong 2.2°K$, are reviewed. Attention is given here to certain aspects related to the appearance of a macroscopically occupied "coherent" mode, which is generally believed to be the most relevant property of the superfluid or superconducting state. A method for the experimental determination of $\rho_c(T)$, the density of the condensate as a function of the temperature, is discussed, as well as a connection between $\rho_c(T)$ and the superfluid density $\rho_s(T)$ of the two fluid model. (MHR)

9945 DERIVATION OF TIME-DEPENDENT GINZBURG—LANDAU EQUATIONS IN SUPERFLUIDS. Taylor, A. W. B. (Univ. of Liverpool). pp 117-128 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

The general structure of the equations of motion for the order parameter in superfluid helium and in superconductors are derived by application of conventional techniques in statistical mechanics. These equations of motion are valid at all temperatures and not only near the lambda point or critical point. It is shown how, near the lambda point and critical point, these equations can be reduced to the usual Ginzburg—Landau equations. (auth)

9946 SCATTERING OF ^{4}He ATOMS BY THE SURFACE OF LIQUID ^{4}He. Kuper, C. G. (Technion-Israel Inst. of Tech., Haifa). pp 129-138 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

A classical hydrodynamical model is proposed which leads to inelastic scattering of helium atoms by the free surface of liquid helium. The qualitative features are in agreement with preliminary experimental results of Edwards' group. The model predicts also that the scattering of rotons impinging on the surface from below will be elastic or nearly elastic. (auth)

9947 BOSE CONDENSATION AND SUPERFLUID HYDRODYNAMICS. Weiss, K.; Haug, H. (Philips Research Labs., Eindhoven, Netherlands). pp 219-235 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

The four basic conservation laws for a superfluid which is characterized by ODLRO are derived without any further assumptions. All relevant physical quantities of the superfluid hydrodynamics are thereby expressed in terms of the first two reduced density matrices. For a diluted, weakly interacting Bose system, for which a solution of the many-body problem exists, the velocity and temperature dependences of all quantities are calculated explicitly. For the general case, in which no such solution is available, the symmetry of the reduced density matrices is exploited to show that the structure of all relevant physical quantities is compatible with Landau's nonlinear two-fluid model. A relation between the densities of the condensate and of the supercomponent is obtained and discussed. (auth)

9948 He MONOLAYER ON GRAPHITE. Nakajima, S. (Tokyo Univ.). pp 287-297 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

The main features of the He monolayer that have so far been revealed by experiments are summarized, and a few theoretical problems that emerge from the experiments are pointed out. Also attempts to understand the main features of the ^{4}He monolayer, at least qualitatively, by means of a simple theoretical model are described. (CES)

9949 SUPERCONDUCTIVITY AND SUPERFLUIDITY. Mendelssohn, K. (Clarendon Lab., Oxford). pp 425-435 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

A brief historical and anecdotal account of progress in low temperature physics from 1911 to the present is presented. (MHR)

9950 FRICTIONAL FORCES AT A RECTILINEAR VORTEX IN LIQUID HELIUM II. Hillel, A. J.; Hall, H. E.; Lucas, P. (Univ. of Manchester, Eng.). J. Phys., C (London); 7: No. 18, 3341-3353(21 Sep 1974).

The frictional forces at a vortex line in rotating liquid helium and generalizations of Landau's hydrodynamical equations are re-examined in the light of recent experimental evidence. There are no unbalanced forces, contrary to a previous suggestion. The mutual friction data are reinterpreted in terms of these new results. (auth)

9951 CHARACTERISTICS OF LIQUID HELIUM. Yamauchi, J. (Nagoya Univ., Japan). Reito; 49: No. 557, 215-222(Mar 1974). (In Japanese).

Special properties of helium-4 are discussed. The critical temperature of helium is 5.20°K, and helium maintains liquid state until 0°K below 25 atmospheric pressure. This phenomena is caused by quantum effect, and the liquid helium is called quantum liquid. The liquid helium shows superfluidity when the temperature is below λ point, and the viscosity is nearly zero. The two-fluid model is proposed for the explanation of these characteristics of helium II. The helium II is considered as a mixed substance of superfluid with no viscosity and fluid with ordinary viscosity. The superfluidity, membrane flow, spring effect, and heat conductivity are explained. The second sound wave was introduced from this model, and the existence was confirmed. Microscopic models for the helium II are ideal Bose gas model and phonon—roton model. Liquid ^{3}He does not show λ transfer. The property of ^{3}He is usually same as ordinary liquid. At the temperature below 0.5°K, however, the property is much different from the ordinary liquid. The specific heat is proportional to temperature, and the magnetization by nuclear spin approaches a value which is independent of temperature. The concept of ideal Fermi gas explains the property qualitatively. The mixture of ^{3}He and ^{4}He and dilute cooling is described. (JA)

9952 HELIUM-3: THE NEW SUPERFLUID. Kendall, J. (Medical Research Council, London). New Sci.; 64: No. 918, 100-102(10 Oct 1974).

In 1972 work was reported by a group at Cornell University showing two probable phase changes, "A" and "B", in a mixture of liquid and solid ^{3}He which had not been seen before as they occur below 5mK. Although these changes were first thought to occur in the solid later it was proved the phase changes in the liquid and explanations of the results suggested superfluidity. Only in early 1974 was firm experimental evidence produced for superfluidity in the "A" phase by measurement of sound propagation through the liquid. The difficulties of studying the new phases of ^{3}He due to the wide range of temperatures, pressures and magnetic fields required, are discussed. Theoretically however various ideas have been confirmed. In particular it seems certain that ^{3}He atoms pair and the most interesting theoretical developments have been concerned with the nature of the pairs. The states involved in the "B" phase are more uncertain than those of the "A" phase. Proposed theoretical models are discussed in the light of experimental data so far available. (UK)

Superconductivity

Refer also to abstracts 9065, 9169, 9170, 9175, 9178, 9179, 9189–9198, 9206, 9207, 9215, 9234, 9235, 9238, 9247, 9262, 9271, 9286, 9949, and 9956.

9953 (COM-74-10757-03) SUPERCONDUCTING DEVICES AND MATERIALS. A Literature Survey Issued Quarterly, July–September 1974. Issue No. 74-3. Olien, N. A. (comp.). (National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). 1974. vp. NTIS $20.00 Per Year.

This bibliography of approximately 1350 references is arranged according to: books, etc.; reviews; experimental techniques; theory; patents; various materials with different T_c; new materials; new mechanisms; mixed state; magnetic behavior; radiation effects; noise; losses; high-frequency behavior; transport and thermal properties; mechanical properties; microscopic and macroscopic applications; etc. A summary of highlights and an author index are included. (DLC)

9954 USE OF INVARIANT TRANSFORMATIONS IN PROBLEMS OF SUPERCONDUCTIVITY. Mancini, F. (Univ., Salerno, Italy). pp 159-188 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

A lecture is given in which it is shown how by using ideas from quantum field theory, it is possible to formulate the theory of superconductivity from a different point of view which offers some advantages over the usual formulation. The basic equations of the boson formulation of superconductivity are derived, and the theory is illustrated by applying it to the study of the magnetic properties of type-II superconductors. (JFP)

9955 MEASUREMENT OF THE COHERENCE DISTANCE OF A PURE TYPE–I SUPERCONDUCTOR. Hauser, J.J. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 10: No. 7, 2792-2798 (1 Oct 1974).

The coherence distance (ξ_0) of the pure type–I superconductors (Al, Pb, and Sn) was measured using the proximity effect with a ferromagnetic Ni film. The experimental values of ξ_0 for Al, Pb, and Sn, which are, respectively, 1.36 μm, 510 Å, and 940 Å, are found to disagree with the BCS theoretical prediction based on the free–electron–like model, the disagreement being worse the less free–electron–like the metal is. These experimental values disagree also with previous determinations of the coherence length obtained by supercooling and superheating experiments and by the magnetic transition of thin films. (auth)

9956 DYNAMICS OF QUASIPARTICLES IN SUPERCONDUCTORS. Hu, P.; Dynes, R.C.; Narayanamurti, V. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 10: No. 7, 2786-2788 (1 Oct 1974).

The dynamics of quasiparticles in superconductors are studied using Sn–oxide–Sn tunnel junctions excited by 30–ns argon–laser pulses. The recombination lifetime and the closure of the superconducting energy gap as a function of laser power are measured. The relationship of these measurements to current theories of quasiparticle dynamics is discussed. (auth)

9957 SPECTRUM OF SUPERCONDUCTING FILMS WITH QUANTIZED RESISTANCES. Kümmel, R. (Institut für Theoretische Physik, Universität Frankfurt am Main, Frankfurt am Main, Germany). Phys. Rev. B 10: No. 7, 2812-2817 (1 Oct 1974).

The lowest–lying quasiparticle states in a superconducting–normal–superconducting layer structure are calculated in the presence of a ground–state current flow parallel to the phase boundaries and an applied magnetic field H parallel to the film surface. Particle–hole scattering at the phase boundaries as well as ordinary reflection processes at the outer film surfaces and at the pair–potential walls are taken into account. Quasiparticle energy and momentum normal to the phase boundaries are obtained as linear functions of a field–dependent parameter $\alpha(H)$, $0 < \alpha(H) < 1/2$, which has been found previously in the experiments on quantized resistances. The relevance of the results with respect to the hypothesis that the bound quasiparticle states are involved in the formation of the observed quantized resistances is discussed. (auth)

9958 PROBE OF SUPERCONDUCTOR FLUCTUATIONS BY A TUNNELING JUNCTION IN A MAGNETIC FIELD. Shenoy, S.R. (Physics Department, Yale University, New Haven, Connecticut 06520); Lee, P.A. Phys. Rev. B 10: No. 7, 2744-2755 (1 Oct 1974).

We consider a tunnel junction with one side superconducting and the other side slightly above the superconducting transition temperature. The fluctuation–induced Josephson current in the presence of a magnetic field is calculated starting from the single–particle tunneling Hamiltonian. Our treatment takes into account nonuniform fluctuations across the normal film and for strong magnetic field deviation from the previously obtained H^2 dependence is predicted. It is also verified that the field has the effect of both suppressing the transition temperature and picking out a particular momentum component of the order–parameter correlation function. (auth)

9959 ACOUSTOELECTRIC EFFECT IN SUPERCONDUCTORS. Gal'perin, Y.M.; Gurevich, V.L.; Kozub, V.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Solid State 16: No. 4, 738-740 (Oct 1974).

The acoustoelectric effect in superconductors is discussed. The effect consists in the onset of a constant current of normal superconductor excitations entrained by a traveling acoustic wave. This current is offset by a superconducting current of equal value and opposite direction. Ultimately the order parameter acquires a phase difference ϑ^{ac} at the ends of the superconductor in which the traveling acoustic wave is propagating, and that phase difference is proportional to the total acoustic power absorbed in the superconductor. The simplest technique for observing the inception of the phase difference is to connect the given superconductor into a closed superconducting circuit. Under the action of the acoustic wave an additional magnetic flux appears, which cuts across the circuit and is equal to $(\vartheta^{ac}/2\pi)\,\Phi_0$, where Φ_0 is the magnetic flux quantum. (auth)

9960 CRITICAL TEMPERATURE OF A SUPERCONDUCTOR CONTAINING TRANSITION METAL IMPURITIES. Kon, L.Z. (Institute of Applied Physics, Academy of Sciences of the Moldavian SSR, Kishinev). Sov. Phys.—Solid State 16: No. 4, 650-652 (Oct 1974).

The effect of transition metal impurities at low concentration on the critical temperature for the superconducting transition is studied on the basis of the Anderson Hamiltonian and the Bardeen–Cooper–Schrieffer interaction. A discontinuous transition from the magnetic case to the nonmagnetic is treated. (auth)

9961 COOPERATIVE PHENOMENA. Haken, H.; Wagner, M. (eds.). New York; Springer-Verlag New York Inc. (1973). 471p. $54.20.

Forty-two papers are included. Separate abstracts were prepared for twelve. The remaining 31 papers were outside the subject scope of NSA. (MHR)

For abstracts of individual papers see: 9935, 9944–9949, and 9962–9966.

9962 ELECTRON–PHONON INTERACTIONS AND SUPERCONDUCTIVITY. Bardeen, J. (Univ. of Illinois, Urbana). pp 63-78 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

The development of the role of electron-phonon interactions in superconductivity is traced. Developments from 1950 to 1957, when the microscopic BCS theory was given, are sketched briefly. In subsequent developments, theory and experiment have developed to such an extent that detailed quantitative information on the electron-phonon interaction can be obtained from experiments on superconductors. (MHR)

9963 MECHANISM FOR SUPERCONDUCTIVITY: TWENTY-TWO YEARS LATER. Rickayzen, G. (Univ. of Kent, Eng.). pp 79-93 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

It is clear from the measured isotope effects of known superconductors that in nearly all of these the electron–phonon mechanism originally proposed by Froehlich plays a part. Although in the early days of the BCS theory it was thought that this mechanism would lead to a value of α equal to $\frac{1}{2}$, it is now realized that it can lead to almost any value, depending on the band structure and the strength of the Coulomb interaction, and that, in principle, it may be the sole mechanism responsible for superconductivity in all known superconductors. Probably, the value of $\alpha = -2$ in U is the hardest to explain in this way. (MHR)

9964 TRANSITION TEMPERATURES OF SUPERCONDUCTORS. Matthias, B. T. (Univ. of California, San Diego, La Jolla). pp 94-95 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

The trials and errors in the search for superconductors with higher transition temperatures are mentioned briefly. Froehlich's contributions are traced. The formal analogy to the piezoelectric effect is emphasized. (MHR)

9965 EFFECT OF STRESS ON THE SUPERCONDUCTIVITY OF TIN. Nabarro, F. R. N.; Rothberg, B. D. (Univ. of the Witwatersrand, Johannesburg). pp 96-107 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

An attempt was made to test the electron–phonon interaction in the BCS theory by varying the stress on tin. Even the measurements under hydrostatic pressure are not accurate enough to distinguish clearly between changes in the Fermi surface and changes in the electron–phonon interaction. The measurements on whiskers under uniaxial tension give accurate information on T_c, but so far, only very rough estimates of the changes of H_0 with strain. However, it seems fairly clear that the influence of the phonon spectrum is more important than that of the Fermi surface, and there is direct evidence of anomalies in the lattice vibrations of tin. (MHR)

9966 TOWARDS A GENERALIZED GINZBURG–LANDAU EQUATION. Hyland, G. J.; Rowlands, G. (Univ. of Warwick, Coventry, Eng.). pp 208-218 of Cooperative Phenomena. Haken, H. (ed.). New York; Springer-Verlag New York Inc. (1973).

By making reasonable assumptions on the space–time dependence of the first reduced density matrix in superconductors, a time-dependent generalization of the Ginzburg–Landau equation is obtained which is valid at all temperatures, provided only that the scale of the space-time variation of the macroscopic wavefunction be sufficiently slow in comparison to that of the phonon-induced electron–electron interaction–a condition equivalent only to assuming the existence of local equilibrium. The structure of the macroscopic wave equation is found to be wave-like over the whole temperature range, in accord with phenomenological considerations but in contradiction to the results of certain analyses based on microscopic theory. (auth)

9967 INCOMPATIBILITY OF BCS PAIRING AND THE PEIERLS DISTORTION IN ONE–DIMENSIONAL SYSTEMS. I. MEAN–FIELD THEORY. Levin, K.; Mills, D.L.; Cunningham, S.L. (Department of Physics, University of California, Irvine, Irvine, California 92664). Phys. Rev. B 10: No. 9, 3821-3831 (1 Nov 1974).

The relationship between the BCS superconducting and Peierls insulating phase transitions in one–dimensional systems is investigated within mean–field theory. This calculation lays the essential theoretical groundwork for a treatment of fluctuations in the two order parameters which is presented in a companion paper. The model Hamiltonian used here is equivalent to the reduced BCS Hamiltonian when the Peierls gap vanishes and also equal to the mean–field approximation to the Fröhlich Hamiltonian, in the presence of electron–electron interactions, when the BCS gap is zero. The two coupled gap equations are derived and solved, and it is found that the two instabilities are, in general, very incompatible. When the "bare" Peierls transition temperature T_P is greater than the "bare" BCS transition temperature T_S, the system generally orders at T_P and is a Peierls insulator at all lower temperatures. The converse is also true. Only when T_P and T_S are nearly equal will the ordered state be the "mixed" state, that in which both order parameters are simultaneously nonzero. This mixed state is shown to exhibit a "one–dimensional Meissner effect." As a side issue, the effect of electron–electron interactions on the Peierls transition (when the BCS gap is zero) is also investigated; it is shown that electron–electron interaction effects are important. Repulsive interactions lower T_P, while attractive interactions raise T_P. These effects are sufficiently severe so that in jellium, with only Coulombic interactions present, T_P is identically zero. (auth)

9968 INCOMPATIBILITY OF BCS PAIRING AND THE PEIERLS DISTORTION IN ONE–DIMENSIONAL SYSTEMS. II. FLUCTUATION EFFECTS. Levin, K.; Cunningham, S.L.; Mills, D.L. (University of California, Irvine, Irvine, California 92664). Phys. Rev. B 10: No. 9, 3832-3843 (1 Nov 1974).

The relationship between the BCS superconducting and the Peierls insulating phase transitions in one–dimensional systems is investigated. This is the second in a series of two papers and treats the effects of simultaneous fluctuations in both order parameters. The coefficients appearing in the Landau–Ginsburg free–energy functional are calculated from the mean–field theory results of the first paper (I), and the statistical–mechanical properties are obtained by expressing the partition function as a functional integral over the Landau–Ginsburg free–energy functional. The problem is reduced to solving for the eigenfunctions and eigenvalues of a particular two–dimensional anharmonic oscillator. Results for the fluctuations and correlation lengths of both order parameters are presented both for a narrow–critical–region model, closely related to that examined by Scalapino, Sears, and Ferrell for the case of one order parameter, and for a wide–critical–region model, based on the approach of Lee, Rice, and Anderson (LRA), who also considered only a single order parameter. The conclusions reached in both models are that fluctuations associated with the lower–critical–temperature order parameter are strongly suppressed. In addition, the correlation length of this order parameter does not appear to grow large as the temperature is lowered. These results support those obtained in I: The BCS and Peierls phase transitions are generally incompatible. Several unexpected and possibly unphysical features of the LRA model for one order parameter are also discussed. (auth)

9969 COMPENSATION CONDITIONS IN THE THEORY OF SUPERCONDUCTIVITY. Varga, B.B.; Aks, S.Ø. (University of Illinois, Chicago, Illinois 60680). Phys. Rev. B 10: No. 9, 3844-3852 (1 Nov 1974).

The compensation conditions determining the superconducting state are investigated in the interacting electron–phonon system using the method of canonical transformations and renormalized perturbation theory. The pairing correlations are introduced via the Bogoliubov–Valatin transformation, and the first–order fermion–phonon interaction is removed by a decoupling transformation which is supposed to be small and is treated perturbatively. The role of small energy denominators, which occur in this transformation and which could invalidate the assumption of smallness, is analyzed carefully. Particular attention is paid to a potential divergence in the transformation which is associated with the threshold for the decay of the quasiparticle through phonon emission. The compensation conditions leading to the Eliashberg and the Bogoliubov effective electron–electron interactions are analyzed, and it is found that the former is consistent with the assumption of a small decoupling transformation, whereas the latter is not. The Bogoliubov effective interaction is also shown to be associated with a divergent contribution to the ground–state energy in fourth order, and is thus based on an inconsistent variational–perturbative treatment. The correct effective interaction for use in the gap equation is found to be that of Eliashberg, in agreement with results of Green's–function theories as well as with tunneling experiments. A variational principle is presented for the quasiparticle energies. (auth)

9970 SOME PROPERTIES OF THE ONE–DIMENSIONAL FERMI MODEL. Fukuyama, H.; Rice, T.M.; Varma, C.M.; Halperin, B.I. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 10: No. 9, 3775-3780 (1 Nov 1974).

A model of one–dimensional fermions characterized by a large momentum–transfer interaction g_1 and a small momentum–transfer interaction g_2 is considered. Results obtained previously by the renormalization–group method are extended by studying the triplet Cooper–pair response function and uniform charge and spin response functions. The sign of g_1 dominates the behavior of the system. For $g_1 > 0$, $g_1 - 2g_2 > 0$ the triplet Cooper response diverges as $T \rightarrow 0$ and is seen to dominate the singlet Cooper response which is also divergent. The uniform static spin susceptibility is nondivergent for $g_1 > 0$ and diverges to zero for $g_1 < 0$. The specific heat is found to be linear in temperature in all regions. These results, obtained by the second–order renormalization group, yield the correct qualitative results in regions where exact solutions are available. (auth)

9971 INTERFERENCE CURRENT IN WEAKLY COUPLED SUPERCONDUCTORS. Volkov, A. F.; Kasatkin, A. L. (Inst. of Radio Engineering and Electronics, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 4, 1527-1533(Oct 1974). (In Russian).

A relation between the current and phase shift is derived on basis of the Ginzburg– Landau time dependent equations which describe the nonstationary Josephson effect in Mercereau–Notarys bridges. The ratio of the interference current to quasiparticle current contains a small parameter λ which characterizes weakness of coupling. (auth)

9972 CALCULATIONS OF THE SUPERCONDUCTING ISOTOPE EFFECT. Leavens, C. R. (National Research Council of Canada, Ottawa). Solid State Commun.; 15: No. 8, 1329-1332 (15 Oct 1974).

The strong-coupling theory of superconductivity is used, without simplification, to compute the isotope effect exponent β in $T_c \alpha M^{-\beta}$ for several metals. A comparison is made with the values obtained using two approximate equations for T_c. (auth)

9973 GINZBURG CRITERION: RATIONALIZED. Amit, D. J. (Hebrew Univ., Jerusalem). J. Phys., C (London); 7: No. 18, 3369-3377(21 Sep 1974).

Following a critique of the various arguments leading to Ginzburg's criterion for the width of the critical region, it is shown that if the unperturbed propagator of fluctuations is expressed in terms of the full susceptibility (mass renormalization) then the width of the critical region follows systematically. The procedure given, automatically, the width of the region about the real transition temperature for which both the Landau and the Ginzburg–Landau theories are valid. Exactly the same logic applies above and below the transition temperature. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 10251, 10349, 10350, and 10351.

9974 INCOHERENT CROSS SECTION FOR NEUTRON QUASIELASTIC SCATTERING IN LIQUIDS, LIQUID CRYSTALS AND MOLECULAR CRYSTALS. Rosciszewski, K. (Uniwersytet Jagiellonski, Krakow (Poland). Instytut Fizyki). Physica; 75: No. 2, 268-282(1974).

The incoherent cross section for neutron quasielastic scattering in anisotropic liquids and molecular crystals is calculated. The model used is similar to that of Larsson. It is shown that in neutron-scattering experiments with a very small momentum transfer $\hbar k$, quasielastic broadening is mainly due to translational diffusion. If k is large, rotational diffusion is the most important. (auth)

9975 TRANSIENTS OF ELASTIC MODERATION THEORY. Sengupta, A.; Srikantiah, G. (Indian Inst. of Tech., Kanpur). J. Phys., D (London); 7: No. 14, 1918-1927(21 Sep 1974).

A complete solution of the neutron slowing-down problem is developed for isotropic elastic scattering in an infinite homogeneous medium. An exact formula for obtaining all the complex roots of the transcendental equation is given. This, together with the exact nontrivial real root determined elsewhere, constitutes the exact solution of the problem. A general misconception about the application of these roots in the first collision interval is pointed out. Numerical results obtained for different magnitudes of absorption rates show agreement with more conventional solutions, like that of Teichmann (Nucl. Sci. Engng.; 7: 292-4 (1960)). The number of terms in the infinite sum necessary for convergence depends on the relative magnitude of lethargy and the pre-assigned permissible error. Good results are obtained with a modest number of terms for small values of relative lethargy, but only with a few for larger values of u/ϵ. (auth)

9976 PROPAGATION IN SPACE AND ANGLE OF NEUTRON FLUX DISCONTINUITIES. Beynon, T. D. (Univ. of Birmingham, Eng.). J. Phys., D (London); 7: No. 14, 1928-1938(21 Sep 1974).

Exact expressions are derived for the time, space and angle dependence of neutron flux discontinuities due to inelastic and elastic scattering. It is demonstrated that these discontinuities can exist for periods of the order of nanoseconds after the initial neutron source pulse. (auth)

9977 ACCURATE MEASUREMENT OF THE WAVELENGTH OF MONOCHROMATIC NEUTRON BEAMS. Bacon, G. E.; Cowlam, N. (Univ. of Sheffield, Eng.). Acta Crystallogr., Sect. A; 30: No. 4, 467-469(1 Jul 1974).

The wavelength of the monochromatic beam of two different neutron diffractometers has been measured with an extrapolation to eliminate systematic errors, similar to that used in x-ray lattice parameter measurements. An accuracy of 1 part in 5000 has been achieved for the instrument at a high-flux reactor. The wavelength measurement provides the first step towards the absolute determination of lattice parameters by neutron diffraction. (auth)

Nuclear Properties and Reactions, $A \leq 5$

Refer also to abstracts 9691, 9904, 10008, 10013, 10114, and 10119.

9978 ABSORPTION EFFECTS IN $d + \alpha$ SCATTERING. Thompson, D.R.; Tang, Y.C. (School of Physics, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. C 10: No. 4, 1566-1569 (Oct 1974).

Absorption effects in $d + \alpha$ scattering are taken into account by a simple modification in the resonating-group formulation. It is shown that this modification results in the elimination of spurious resonances and leads to a satisfactory agreement with measured values for differential scattering and total reaction cross sections. (auth)

9979 α-α SCATTERING IN THE GENERATOR-COORDINATE FORMALISM. Lumbroso, A. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, BP No 2 — 91190 Gif-sur-Yvette, France). Phys. Rev. C 10: No. 4, 1271-1281 (Oct 1974).

In the generator-coordinate formalism we calculate the phase shifts for $\alpha-\alpha$ scattering by solving the Hill-Wheeler equation in the continuum. The Pauli principle is exactly taken into account for the nuclear potential term. The Coulomb interaction is introduced under a long-range assumption. The results are compared to the experimental values. (auth)

9980 PARTIAL-WAVE DISPERSION RELATIONS FOR THE NONRELATIVISTIC FIVE-NUCLEON SYSTEM. Stingl, M. (University of Freiburg, Freiburg, West Germany); Rinat (Reiner), A.S. Phys. Rev. C 10: No. 4, 1253-1270 (Oct 1974).

Partial-wave dispersion relations for the coupled α + n and t + d channels of the Z = 2 five-nucleon system have been solved by the matrix N/D technique. Driving terms have been constructed from one- and two-cluster exchange graphs with parameters of vertex functions taken from studies of $A \leq 4$ subsystems. Accurate solutions to the coupled N and D equations have been obtained by a Pagels approximation based on [N,N-1] Padé approximants. Coulomb forces in charged-fragment channels were incorporated via the repeated N/D scheme of Kinoshita and Kugler. No proper treatment has been given of the anomalous threshold of the $t + d \rightarrow \alpha + n$ proton-exchange graph. Calculated α + n scattering phase shifts lack uniqueness, due to strong sensitivity to the inaccurately known vertex parameters used as input, but display the basic features of repulsion in the s wave, occurrence of resonances in the p waves, and existence of the small $3/2^+$, d-wave resonance just above the t + d threshold. Failure of the calculation to produce the width of the p-wave resonances is attributed to the improper treatment of the anomalous threshold. Differential cross sections for $t + d \rightarrow \alpha + n$ show reasonable agreement with experiment in both the forward and backward directions but lack details of the observed structure at medium angles. The latter again occurs for the calculated t + d elastic scattering cross sections, which, moreover, are unsatisfactory at forward angles. A comparison with other coupled-channel calculations of light systems is attempted. (auth)

9981 SUPERSOFT-CORE NUCLEON-NUCLEON INTERACTION AND CIRCULAR POLARIZATION OF THE GAMMA RAY IN n-p CAPTURE. Rusgi, M. L.; Sandhu, T. S.; Tischler, M. (New York State Univ., Buffalo). Lett. Nuovo Cim.; 11: No. 13, 587-589(30 Nov 1974).

The circular polarization of the gamma ray emitted in the n-p capture is calculated by employing the supersoft-core potential. The calculations are carried out for five models which lead to different parity-violating nucleon-nucleon interactions mediated by charged and neutral vector mesons. (JFP)

9982 THE ^{3}H-d-n AND ^{4}He-^{3}He-n COUPLING CONSTANTS FROM PERIPHERAL MODEL CALCULATIONS. Dolinsky, E. I.; Mukhamedzhanov, A. M. (Moskovskij Gosudarstvennyj Univ. (USSR). Inst. Yadernoj Fiziki). Phys. Lett., B; 52: No. 1, 17-20 (16 Sep 1974).

A set of the t-d-n and α-h-n coupling constants from the peripheral model analyses of single-particle transfer reactions is presented. Comparison with the results obtained by other methods currently used shows that the peripheral model is an effective tool for extracting the nuclear coupling constants from direct reaction data. (auth)

9983 PHOTODISINTEGRATION OF THE DEUTERON AT 15-25 MeV PHOTON ENERGY. Ahrens, J.; Eppler, H. B.; Gimm, H.; Kroening, M.; Riehn, P.; Waeffler, H.; Zieger, A.; Ziegler, B. (Max-Planck-Institut fuer Chemie (Otto-Hahn-Inst.), Mainz (F.R. Germany)). Phys. Lett., B; 52: No. 1, 49-50(16 Sep 1974).

The total cross section for the photodisintegration of the deuteron has been measured at 15, 20 and 25 MeV photon energy. The results agree with theory within the experimental errors of ±5% and do not confirm a 20% discrepancy between experiment and theory as previously reported in the literature. (auth)

9984 MUON CAPTURE IN DEUTERIUM WITH REALISTIC POTENTIALS. Sotona, M.; Truhlik, E. (Ustav Jaderne Fyziky, Rez (Czechoslovakia)). Nucl. Phys., A; 229: No. 3, 471-483 (9 Sep 1974).

The transition rates for muon capture in deuterium are calculated using the Reid soft-core deuteron and $^1S_0$ and ^3P_J ($J = 0, 1, 2$) neutron-neutron wave functions. The validity of the closure approximation and of the Omnes-Muskhelishvili method is studied. The off-shell effects admissible in a class of phase-shift-equivalent potentials by present experimental data are evaluated. (auth)

9985 MEASUREMENTS ON D(d,d′p)n QUASIFREE SCATTERING BETWEEN 45 AND 80 MeV. Hrehuss, G.; Kelleter, H.; Mayer-Boericke, C. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Kernphysik). Phys. Lett., B; 51: No. 5, 454-456(2 Sep 1974).

The quasifree scattering of deuterons on protons using a deuteron target has been measured at different bombarding energies between 45 and 80 MeV. An unexpected dip in the excitation function of the cross section shows up at about 60 MeV. (auth)

9986 THE HILBERT–SCHMIDT METHOD IN THE THREE-PARTICLE PROBLEM AND DETERMINATION OF THE VERTEX PARTS tdn AND td*n. Baryshnikov, A. G.; Blokhintsev, L. D. (Moskovskij Gosudarstvennyj Univ. (USSR). Inst. Yadernoj Fiziki); Narodetsky, I. M. (AN SSSR, Moscow. Fizicheskij Inst.). Phys. Lett., B; 51: No. 5, 432–434(2 Sep 1974).

Vertex constants for virtual decays $t \rightarrow d + n$ and $t \rightarrow d^* + n$ are calculated using the resonance expansion technique for the three-particle amplitude suggested recently by Narodetsky et. al. [Yadern. Fiz., 16: 707(1972)]. In the model with a spin-dependent separable NN potential, values $G^2_{tdn} = 1.92$ fm, $G^2_{td^*n} = -0.38$ fm are obtained. (auth)

9987 ANGULAR DISTRIBUTION OF POLARIZATION TRANSFER IN $^2H(\vec{d},\vec{p})^3H$. Gruebler, W.; Hardekopf, R. A.; Armstrong, D. D.; Keaton, P. W. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Phys., A; 230: No. 2, 353–357(23 Sep 1974).

Measurements were made of seven polarization transfer coefficients for the $^2H(\vec{d},\vec{p})^3H$ reaction. The experiment used a polarized deuteron beam from the Los Alamos Scientific Laboratory Lamb-shift polarized ion source, a liquid-nitrogen cooled deuterium gas target, a magnetic quadrupole triplet for focusing the reaction protons and a helium filled polarimeter for simultaneously measuring the proton polarization along two transverse axes. Results were obtained at 10 MeV and for lab angles of 15, 30, 45 and 60° for the vector transfer coefficients $K_x^{x'}$, $K_y^{y'}$ and $K_z^{x'}$, and the tensor transfer coefficients $K_{xx}^{y'}$, $K_{yy}^{y'}$, $K_{zz}^{y'}$ and $K_{xz}^{y'}$. (auth)

9988 ODD-EVEN FEATURES IN $^3He + {}^3H$ SCATTERING. Brown, R. E.; Chwieroth, F. S.; Tang, Y. C.; Thompson, D. R. (Minnesota Univ., Minneapolis (USA). School of Physics). Nucl. Phys., A; 230: No. 2, 189–194(23 Sep 1974).

The single-channel resonating-group method is used to study effects of the Pauli principle on $^3He + {}^3H$ scattering. Comparison is made with previous similar calculations for $d + {}^3He$ scattering, and it is found that the Pauli principle affects the $s = 0$ state of the $^3He + {}^3H$ system rather similarly to the way it affects the $s = 1$ state, whereas the Pauli principle affects the $s = 3/2$ state of the $d + {}^3He$ system quite differently from the way it affects the $s = 1/2$ state. Mention is made of the possibility of observing similar effects of the Pauli principle in other nuclear systems. (auth)

9989 INTERACTION EFFECTS IN THE PHOTODISINTEGRATION OF THE DEUTERON UP TO 140 MeV. Arenhovel, H.; Fabian, W. (Mainz Univ. (F. R. Germany). Inst. fuer Kernphysik); Miller, H. G. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 52: No. 3, 303–305(14 Oct 1974).

The influence of isobar admixture and meson exchange current effects on the total and differential cross section and the polarization in the reaction d(γ,p)n is investigated. At threshold meson exchange dominates, while above 80 MeV the isobar configurations give the largest contribution. Both interaction effects lead to a good agreement with experiment for both total cross section and angular distributions. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 9905, 10024, 10038, 10044, 10074, 10118, 10119, 10128, and 10132.

9990 (AD-784084) STUDY OF NEUTRON ANGULAR DISDISTRIBUTIONS FROM THE $^9Be(d,n)^{10}B$ REACTION. Final Report. Park, Y. S.; Niiler, A.; Lindgren, R. A. Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA); Army Materiel Command, Washington, D. C. (USA)). Jul 1974. 64p. (BRL-1732). NTIS $4.00.

The $^9Be(d,n)^{10}B$ reaction was studied extensively in order to gain detailed information on the structure of the neutron energy spectrum from this neutron-source reaction. The present scattering facilities in the neutron room are well suited for the detection of neutrons from (d,n) reactions with an optimum experimental resolution. The (d,n) reaction was also studied in order to test capabilities of the existing direct-reaction computer codes for analyses of neutron inelastic-scattering data. The results and information gained from this study will be used directly in the analysis of (^{3}He,n) reactions which were also studied in support of the neutron cross section program at this laboratory. (auth)

9991 (ANU-P-600) DIRECT REACTIONS TO MANY-CHANNEL, MANY-LEVEL FINAL STATES II: (d,p)n AND (^{3}He,d)p. Treacy, P. B. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Sep 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

The cross section for a direct reaction to a generalized positive-energy final state, described by an R-matrix wave function, was previously derived. A distinction is emphasized between two classes of such a reaction, depending on whether it can or cannot decay back to the target state. The major contribution in the latter case can be via direct break-up. This is computed for the reaction $^7Li(^3He,d)^8Be(p)^7Li$, treated by a stripping mechanism. The dependence of the cross section on the final-state (^{8}Be) channel energy is discussed. Shell-model wave functions are used for R-matrix basis states, and this is shown to be appropriate and useful for direct reactions. (auth)

9992 (OU-LNS-74-4) QUADRUPOLE MOMENT OF β-EMITTER ^{17}F. Minamisono, T.; Nojiri, Y.; Mizobuchi, A.; Sugimoto, K. (Osaka Univ., Toyonaka (Japan). Lab. of Nuclear Studies). [nd]. 18p. Dep. NTIS (US Sales Only) $4.00.

The quadrupole effect in NMR of $^{17}F(I^{\pi} = 5/2^+,\ T_{1/2} = 66s)$ in a MgF_2 single crystal was investigated. Production and implantation of polarized ^{17}F through the $^{16}O(d,n)$ reaction and the resultant asymmetric β decay were utilized. The quadrupole coupling constant is determined to be $|eqQ/h| = (8.41 \pm 0.24)$ MHz with $\eta = (0.32 \pm 0.02)$ at room temperature. No appreciable temperature dependence of eqQ is found from 77 K up to 770 K. Using the previously known results, the following ratios of the quadrupole moments are obtained: $|Q(^{17}F, 5/2^+)| : |Q(^{18}F^*, 5^+)| : |Q(^{19}F^*, 5/2^+)| : |Q(^{20}F, 2^+)| = 1 : (1.33 \pm 0.08) : (1.24 \pm 0.06) : (0.69 \pm 0.02)$. The additivity relation of Q between ^{17}F, ^{17}O, and $^{18}F^*$ is discussed. (auth)

9993 DISTORTIONS IN ANGULAR CORRELATIONS FOR THE REACTION $^{11}B(d, p\gamma)^{12}B^*$ (0.95 MeV) AT LOW ENERGY. Karfunkel, U.; Sellschop, J.P.F.; Stemmet, M.C. (Nuclear Physics Research Unit, University of the Witwatersrand, Johannesburg, Republic of South Africa). Phys. Rev. C 10: No. 4, 1596-1598 (Oct 1974).

For the reaction $^{11}B(d, p\gamma)^{12}B^*$ (0.95 MeV) at $E_d = 1$ MeV, 15 angular correlation measurements covering the range $\theta_{dp} = 22°$ to 160° give values of the anisotropy (ε) and the deviation of the measured symmetry axis from the recoil axis (ΔΦ). The values of ΔΦ remain small and constant throughout, whereas the values of ε increase sharply at backward angles to a high, possibly constant value. These results are surprising in the simplicity of their behavior and are contrary to some features and anticipations of previously reported measurements. (auth)

9994 LINEAR RELATIONS BETWEEN HIGH–PURITY ENERGY LEVELS IN A = 12–16 NUCLEI. van der Merwe, J.H.; Villet, C.M. (Merensky Institute for Physics, University of Stellenbosch, Stellenbosch, South Africa). Phys. Rev. C 10: No. 4, 1498-1504 (Oct 1974).

We have assumed the T = 0 and 1 negative–parity quartets of levels in A = 14 nuclei, as well as the T = 1 negative–parity quartet in A = 16 nuclei, to represent pure configurations. Linear relationships between the energies of these groups of levels produce results which are consistent with the relevant part of the single–particle energy spectrum in this region. From the given A = 14 energy values conclusions are made concerning the low positive–parity levels in A = 15. Due consideration is given to the necessary Coulomb corrections in all the calculations. (auth)

9995 $^7Li(p, n_0)^7Be$ ANGULAR DISTRIBUTIONS TO $E_p = 3.8$ MeV. Burke, C.A.; Lunnon, M.T.; Lefevre, H.W. (Department of Physics, University of Oregon, Eugene, Oregon 97403). Phys. Rev. C 10: No. 4, 1299-1308 (Oct 1974).

Differences between results from earlier measurements of the $^7Li(p, n_0)^7Be$ differential cross section have prevented use of the neutron spectrum from this reaction as a standard of neutron intensity. Differential excitation curves for the reaction were obtained at 15 angles for proton energies between 2.1 and 3.8 MeV. A pulsed proton beam incident upon a thick lithium metal target produced continuous neutron spectra which were measured by time of flight. The data were corrected for neutron scattering from the target. The neutron detector efficiency was determined through a simultaneous normalization of the measured angular distributions to the known total cross section at all proton energies. The efficiency determination was judged to be uncertain to about 5%. Resultant differential excitation curves have uncertainties between 5 and 8%. The zero degree differential cross section (E_p = 1.89 to 3.8 MeV), and the excitation functions and Legendre coefficients (E_p = 2.09 to 3.80 MeV), are presented in 10–keV increments and compared with other measurements. (auth)

9996 PHOTODISINTEGRATION OF ^{6}Li BELOW THE $^3He-{}^3H$ THRESHOLD. Ghovanlou, A.; Prats, F. (Department of Physics, The George Washington University, Washington, D.C. 20006). Phys. Rev. C 10: No. 4, 1309-1318 (Oct 1974).

The cross section for the photodisintegration reaction $\gamma + {}^6Li \rightarrow \alpha + p + n$ has been calculated for photon energies from threshold (E_γ = 3.70 MeV) up to E_γ = 16 MeV utilizing dispersion theory methods.

In this energy region, the dominant contribution to the transition amplitude results from diagrams characterized by the virtual breakups $^6Li \rightarrow \alpha + d$, $^6Li \rightarrow p(n) + {}^5He_{g.s.}({}^5Li_{g.s.})$, and rescattering corrections. In the calculation, the coupling constant for the $^6Li \rightarrow \alpha + d$ vertex is obtained from an analysis of quasielastic cross sections for $^6Li(p,pd)^4He$. The $^6Li \rightarrow p + {}^5He_{g.s.}$ coupling constant is determined from an analysis of quasielastic cross section for $^6Li(p,2p)^5He_{g.s.}$. The predicted σ (γ,n) cross section agrees both in shape and magnitude with the experimental results. The calculated cross section integrated up to the $^3H-{}^3He$ threshold is 13.0 MeV mb, while experimentally it is found to be 12.4–14.6 MeV mb. (auth)

9997 WIDTHS OF LOW–LYING STATES OF ^{13}N AND THE QUESTION OF REACTION DEPENDENCE. Blatt, S.L. (Department of Physics, The Ohio State University, Columbus, Ohio 43210 and Laboratoire des Basses Energies, Centre de Recherches Nucléaires and Université Louis Pasteur, Strasbourg, France); Marolt, G.L.; Goss, J.D. Phys. Rev. C 10: No. 4, 1319-1330 (Oct 1974).

The width of the first excited state of ^{13}N has been studied through high resolution $^{12}C(p,\gamma)^{13}N$ and $^{12}C(^3He,d)^{13}N$ measurements. Extracted values of this quantity were found to have wide variations when the data were analyzed with different assumptions concerning backgrounds and reaction theories. A previous suggestion that existing data show statistically significant differences in this width when observed in different reactions is not supported by these studies. Width values for the second and third excited states of ^{13}N have also been extracted from the $(^3He,d)$ measurements. (auth)

9998 LOWEST $T = 2$, $J^\pi = 0^+$ STATE IN ^{12}C. Goosman, D.R. (Brookhaven National Laboratory, Upton, New York 11973); Geesaman, D.F.; Cecil, F.E.; McGrath, R.L.; Paul, P. Phys. Rev. C 10: No. 4, 1525-1528 (Oct 1974).

Utilizing the $^{10}Be(^3He, n)$ reaction the lowest 0^+ $T = 2$ state of ^{12}C has been located at 27.611 ± 0.020 MeV. The result agrees with earlier (p, t) measurements on ^{14}C. The $T = 2, 1, 0$ splitting of 2p–2h, 0^+ states in ^{12}C is discussed. (auth)

9999 $^{18}O(p,t)^{16}O$ REACTION AND THE COEXISTENCE MODEL OF ^{16}O. Fleming, D.G. (Department of Chemistry, University of British Columbia, Vancouver, Canada, V6T 1W5); Arima, A.; Fulbright, H.W.; Blann, M. Phys. Rev. C 10: No. 4, 1350-1361 (Oct 1974).

The $^{18}O(p,t)^{16}O$ reaction has been studied at 20 MeV. Relative cross sections to the ground (0^+), 6.05 MeV (0^+), 6.92 MeV $(2^+,K = 0)$, and 9.85 MeV $(2^+,K = 2)$ states have been compared with standard distorted–wave Born–approximation (DWBA) calculations using SU_3 parentage factors and the nuclear coexistence model. The agreement is good for the 0^+ states but poor for the 2^+ states, given the uncertainties inherent in the DWBA calculation itself. The presence of competing second–order processes is indicated by the relatively strong population of the 8.88-MeV 2^- level. (auth)

10000 WEAK STATES IN $^{19}F(d,p)^{20}F$. Fortune, H.T.; Betts, R.R. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 10: No. 4, 1292-1298 (Oct 1974).

The $^{19}F(d,p)^{20}F$ reaction has been reinvestigated with special emphasis on the weak states. The structure of all states below 4.2 MeV is reviewed and compared with $(sd)^4$ and open–core shell–model calculations. (auth)

10001 ALPHA–PARTICLE MOLECULES IN LOW–ENERGY HEAVY–ION REACTIONS. Voit, H. (Cyclotron Institute, Texas A & M University, College Station, Texas 77843); Dück, P.; Galster, W.; Haindl, E.; Hartmann, G.; Helb, H. D.; Siller, F.; Ischenko, G. Phys. Rev. C 10: No. 4, 1331-1344 (Oct 1974).

From a survey of the heavy–ion systems measured until now two conditions can be deduced empirically which must be fulfilled in order to find correlated resonances of the type measured in the low–energy excitation functions of the $^{12}C + {}^{12}C$ reaction. With both conditions one is able to explain simultaneously the lack and the existence of correlated resonances in all measured reactions. The conditions are: (1) the level density of the corresponding compound nuclei and the number of open channels must be small, and (2) both nuclei in the entrance channel must be α–particle nuclei. The latter condition seems reasonable because experimental evidence exists for the assumption that these resonances are due to α–particle doorway states. (auth)

10002 DETERMINATION OF THE EXCITATION FUNCTIONS OF THE REACTIONS $^{19}F(P,\alpha_0)^{16}O$ AND $^7Li(P,\alpha_0)^4He$ BETWEEN 150 AND 1800 keV. Application to the Measurement of Surface Concentrations of Lithium and Fluorine. Golicheff, I.; Loeuillet, M.; Engelmann, C. (CEN de Saclay, Gif-sur-Yvette, France). J. Radioanal. Chem.; 22: No. 1-2, 113-129(1974). (In French).

The experimental device used is described. Excitation functions are given for an angle of observation of 150° with respect to the incident beam. The possibilities of applying these reactions to the measurement of surface lithium and fluorine concentrations are considered. The detection limits for these two elements are shown to be 5×10^{-3} $\mu g \cdot cm^{-2}$ with protons of energy between 1,350 and 1,500 keV. The method is compared with that based on the detection of prompt γ rays from the reactions $^7Li(p,\gamma)^8Be$ and $^{19}F(p,\alpha\gamma)^{16}O$. (auth)

10003 THE $^6Li(e,e'\alpha)$ AND $^6Li(e,e'd)$ REACTIONS AT 520 MeV. Genin, J. P.; Julien, J.; Rambaut, M.; Samour, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Dept. de Physique Nucleaire); Palmeri, A.; Vinciguerra (Catania Univ. (Italy). Istituto di Fisica). Phys. Lett., B; 52: No. 1, 46-48(16 Sep 1974).

The reactions $^6Li(e,e'\alpha)$ and $^6Li(e,e'd)$ have been studied at $T_0 \sim 520$ MeV and $q \sim 1.4$ fm^{-1}, by coincidence measurements. The angular dependence of the cross sections is interpreted in the plane-wave impulse approximation to obtain the momentum distribution of α-particle and deuteron clusters in ^6Li. The amount of clustering of ^6Li is also discussed. (auth)

10004 TOTAL π-MESON PHOTOPRODUCTION CROSS SECTION FOR LITHIUM AND BERYLLIUM. Ahrens, J.; Eppler, H. B.; Gimm, H.; Kroening, M.; Riehn, P.; Zieger, A.; Ziegler, B. (Max-Planck-Institut fuer Chemie (Otto-Hahn-Inst.), Mainz (F.R. Germany)). Phys. Lett., B; 52: No. 1, 43-45(16 Sep 1974).

The total photon absorption cross section for natural Li and Be have been measured up to 220 MeV photon energy. The rise of the cross section above an "apparent" threshold of about 170 MeV indicates the main onset of π-meson photoproduction. The cross section at 200 MeV is larger for Li than for Be (1.25 mb and 0.8 mb, respectively) and the integrated cross section from the apparent π-production threshold to 220 MeV constitutes a sizeable fraction of the classical dipole sum (34% and 24%, respectively). (auth)

10005 THE (τ,α) REACTION AT 216 MeV. Gerlic, E.; van de Wiele, J.; Langevin-Joliot, H.; Didelez, J. P.; Duhamel, G. (Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire); Rost, E. (Colorado Univ., Boulder (USA)). Phys. Lett., B; 52: No. 1, 39-42(16 Sep 1974).

The (τ,α) reaction on ^{12}C and ^{16}O targets has been studied at $E_\tau = 216$ MeV using the Orsay synchrocyclotron beam in order to investigate the reaction mechanism at high energy and large momentum transfer. The (τ,α) reaction at 216 MeV yields large cross sections and may be analyzed as a direct pickup reaction, although two-step processes can be quite important for some transitions. Such measurements can extend the nuclear structure results obtained at lower energies. (NL)

10006 ON THE DIRECT REACTION MECHANISM OF THE $^6Li(p,\tau)^4He$ REACTION. Schenk, K.; Moerike, M.; Staudt, G. (Tuebingen Univ. (F.R. Germany). Physikalisches Inst.); Turek, P. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Kernphysik); Clement, D. (Tuebingen Univ. (F.R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 52: No. 1, 36-38(16 Sep 1974).

Differential cross sections for the reaction $^6Li(p,\tau)^4He$ have been measured at several energies between $E_p = 22.5$ and 40.0 MeV. Calculations using cluster-model direct reaction formulas are successful in describing these data. There are reasons why, for energies lower than 20 MeV, compound formation cannot be neglected. (auth)

10007 ON POSSIBLE COLLECTIVE EFFECTS IN THE POSITIVE PARITY PARTICLE-HOLE STATES OF ^{16}O. Ellis, P. J. (Oxford Univ. (UK). Nuclear Physics Lab.); Osnes, E. (Oslo Univ. (Norway). Fysisk Institutt). Phys. Lett., B; 52: No. 1, 31-35(16 Sep 1974).

The positive-parity particle–hole states in ^{16}O were investigated in various TDA and RPA calculations. Their decay strength to ground was evaluated for general operators acting in orbital spin and isospin space in order to search for possible collective effects. Some evidence was obtained for a weak collectivity for the hexadecapole state and some of the spin-multipole states, particularly in the case $J = 2$, $T = 0$, if a harmonic oscillator basis is used. (auth)

10008 THE BREMSSTRAHLUNG WEIGHTED CROSS SECTION AND TWO-BODY CORRELATIONS IN NUCLEI. Weng, W. T.; Kuo, T. T. S. (State Univ. of New York, Stony Brook (USA). Dept. of Physics); Ratcliffe, K. F. (State Univ. of New York, Albany (USA). Dept. of Physics). Phys. Lett., B; 52: No. 1, 5-9(16 Sep 1974).

The effect of two-body correlations on the calculation of the bremsstrahlung-weighted cross section σ_{-1} is investigated for ^4He, ^{16}O and ^{40}Ca by making partial sums of the linked-cluster expansion. It is found that σ_{-1} is sensitive to long-range correlations but is quite insensitive to the inclusion of short-range correlations. (auth)

10009 HYPERFINE STRUCTURE IN HIGHLY IONIZED ^{13}C ATOMS AND THE MAGNETIC MOMENT OF THE $5/2^+$ STATE AT 3.85 MeV. Beene, J. R.; Asher, J.; Ayres de Campos, N.; Gill, R. D.; Grace, M. A.; Randolph, W. L. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Phys., A; 230: No. 1, 141-152(16 Sep 1974).

The time dependence of the angular correlation due to the hyperfine interaction of the 3.85-MeV $5/2^+$ level of ^{13}C ($\tau_m = 12.4 \pm 0.8$ ps) in carbon ions of high-charge states has been investigated. The highest frequency seen was attributed to the hyperfine interaction of a single K-electron with the nuclear state, and from this a value for the nuclear g-factor of the 3.85-MeV level, $|g| = 0.59 \pm 0.05$, can be inferred. The results also provide information on the atomic ground-state occupancies in the 4^+ and 5^+ carbon ions, after emergence from a target foil at a velocity $v/c \approx 0.04$. (auth)

10010 ELASTIC AND INELASTIC SCATTERING OF ^{18}O BY ^{16}O AND ^{18}O. Vandenbosch, R.; Reisdorf, W. N.; Lau, P. H. (Washington Univ., Seattle (USA)). Nucl. Phys., A; 230: No. 1, 59-69(16 Sep 1974).

Angular distributions have been measured for the elastic and inelastic scattering of ^{18}O by ^{16}O and ^{18}O at laboratory bombarding energies of 42 and 52 MeV. The inelastic scattering data are analyzed in terms of collective excitations by using a coupled-channel approach. Deformation parameters are obtained for the strongly excited states. The relationship between the strength of inelastic scattering and the amount of structure in the elastic scattering distributions is discussed. (auth)

10011 THE ^{12}C(p, d)^{11}C REACTION AT 700 MeV. Baker, S. D.; Bertini, R.; Beurtey, R.; Brochard, F.; Bruge, G.; Catz, H.; Chaumeaux, A.; Cvijanovich, G.; Durand, J. M.; Faivre, J. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Phys. Lett., B; 52: No. 1, 57-59(16 Sep 1974).

Angular distributions for the excitation of the lowest five ^{11}C states have been measured in the ^{12}C(p, d)^{11}C reaction at $E_p = 700$ MeV. The reaction can be described in terms of a pick-up mechanism. A crude DWBA analysis gives results in qualitative agreement with the data. The relative importance of the $5/2^-$ and $7/2^-$ state excitations is explained in terms of a two-step process involving the inelastic excitation of the ^{12}C target. Such processes are relatively important at high momentum transfers where the single-step form factor is very small. Finally, the predicted angular distributions show more structure than the data, indicating the possibility that other physical effects (e.g. N* transfer) may be observable in high-energy rearrangement reactions. (NL)

10012 NUCLEAR MAGNETIC RESONANCE OF ^{8}Li IN LiNbO$_3$ AND THE QUADRUPOLE MOMENT OF ^{8}Li. Ackermann, H.; Dubbers, D.; Grupp, M.; Heitjans, P.; Stoeckmann, H. J. (Heidelberg Univ. (F. R. Germany). 1. Physikalisches Inst.). Phys. Lett., B; 52: No. 1, 54-56(16 Sep 1974).

Nuclear magnetic resonance measurements were carried out on neutron-activated ^{8}Li($T_{1/2} = 0.84$ s) nuclei in a single crystal of LiMbO$_3$. The quadrupolar-split NMR spectrum, detected via the ^{8}Li β radiation, could be resolved. The quadrupole coupling constant was determined to $|e^2qQ/h| = 43 \pm 3$ kHz at room temperature. Comparison with the coupling constant of ^{7}Li in LiNbO$_3$ leads to the value of the quadrupole moment $|Q({}^{8}\mathrm{Li})| = 32 \pm 6$ mb. (auth)

10013 THE NEUTRON TOTAL CROSS SECTION MEASUREMENTS ON PROTONS AND NUCLEI IN THE ENERGY RANGE OF 28-54 GeV. Babaev, A.; Brachman, E.; Eliseev, G.; Ermilov, A.; Galaktionov, Yu.; Kamishkov, Yu.; Lubinov, V.; Lugetsky, N.; Nagovitzin, V.; Nozik, V. (AN SSSR, Moscow. Fizicheskij Inst.). Phys. Lett., B; 51: No. 5, 501-504(2 Sep 1974).

The results of the total cross section measurements of neutrons on protons, deuterons and nuclei C, O, Al, Cu, Sn, Pb in the energy range of 28–54 GeV are reported. The experiment has been carried out at the Serpukhov 70-GeV synchrotron for three intervals of the neutron energies corresponding to the internal proton beam energy of 35, 50 and 70 GeV. The conventional transmission technique was used; i.e., the intensity of the beam passing through the target without an interaction was measured. The theory is in agreement with the experimental data if one assumes some energy dependence of the nucleon–nucleon total cross sections over the studied energy interval. (auth)

10014 NUCLEAR STRUCTURE OF LIGHT NUCLEI USING THE SELECTIVITY OF HIGH ENERGY TRANSFER REACTIONS WITH HEAVY IONS. Anyas-Weiss, N.; Cornell, J. C.; Fisher, P. S.; Hudson, P. N.; Menchaca-Rocha, A.; Millener, D. J.; Panagiotou, A. D.; Scott, D. K.; Strottman, D.; Ellis, P. J. (Oxford Univ. (UK). Nuclear Physics Lab.). Phys. Rep.; 12: No. 3, 201-272(Aug 1974).

Data obtained by bombarding light nuclei with beams of ^{11}B, ^{12}C and ^{14}N at energies of about 10 MeV/nucleon is presented. Reactions involving transfers of various numbers of nucleons were investigated and the spectra of the detected ions correspond to a wide range of excitation energies in the residual nuclei. The results characteristically show only a few strong peaks in each spectrum and the cross sections exhibit many of the features of direct reactions. The apparent high degree of selectivity is explained in terms of the interplay of reaction mechanisms and the structure of the strongly populated states. Firstly, it is shown that a simple semiclassical model of the reaction process indicates that states of the final nucleus with high spin are greatly favored. On the other hand, it is demonstrated that the shell model gives a reasonably complete explanation for the occurrence of such high spin states at the appropriate excitation energies. These shell-model states are found to be dominated by configurations with the structure of a multi-nucleon cluster, in the ground state of its internal motion, orbiting the core nucleus so that the center of mass motion of the cluster carries all the excitation quanta. (auth)

10015 BEHAVIOR OF THE EFFECTIVE INTERACTION THROUGH THIRD ORDER IN G. Goode, P. (Rutgers–The State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Phys. Lett., B; 51: No. 5, 429-431(2 Sep 1974).

To investigate the usual assumption of rapid perturbative convergence, the (sd)-shell effective interaction is calculated including effects through third order for mass-18. All JT states are considered. Third-order effects on the T = 1 states tend to be small compared to corresponding second-order effects. Some evidence for non-convergent behavior is found in T = 0 states. (auth)

10016 TOWARDS AN IMPROVED EFFECTIVE INTERACTION. Watt, A.; Cole, B. J.; Whitehead, R. R. (Glasgow Univ. (UK). Dept. of Natural Philosophy). Phys. Lett., B; 51: No. 5, 435-438 (2 Sep 1974).

Shell-model calculations have been performed for ^{18}O and ^{18}F including all the $2\hbar\omega$ configurations normally treated by perturbation theory in deriving effective interactions for the sd shell. The results provide a unique test of present methods used in deriving these interactions. (auth)

10017 THE STUDY OF (d, t) AND (d, ^{3}He) REACTIONS IN SEVERAL 1p SHELL NUCLEI USING VECTOR-POLARIZED BEAMS. Ludwig, E. J.; Busch, C. E.; Clegg, T. B.; Datta, S. K.; Watkins, A. C. (North Carolina Univ., Chapel Hill (USA)). Nucl. Phys., A; 230: No. 2, 271-284(23 Sep 1974).

Cross section and vector analyzing power angular distributions using 15-MeV deuterons were taken over an angular range of Θ_{lab} = 20 to 100° for the ^{10}B(d,t) ^{9}B$_{g.s.}$ and 2.36 MeV state, ^{10}B(d,^{3}He) ^{9}Be$_{g.s.}$ and 2.43 MeV state, ^{13}C(d,t)^{12}C$_{g.s.}$, ^{14}N(d, t)^{13}N$_{g.s.}$, and ^{14}N(d, ^{3}He)^{13}C$_{g.s.}$ reactions, and vector analyzing power data alone were taken for the ^{16}O(d,t)^{15}O$_{g.s.}$ and ^{16}O(d, ^{3}He)^{15}N$_{g.s.}$ reactions. Beams of vector-polarized deuterons were used for the vector analyzing power determinations. A comparison is made of the results for (d, t) and (d, ^{3}He) reactions leading to mirror states when the self-conjugate targets ^{10}B and ^{14}N are used. The reactions provide evidence for a j-dependence of the vector analyzing power for l = 1 transfers in 1p shell nuclei. When the reactions involve a j-value admixture, the vector analyzing powers are used to attempt to determine percentage admixtures involved in the population of several final states. (auth)

10018 YIELD OF ^{18}F FOR VARIOUS REACTIONS FROM OXYGEN AND NEON. Nozaki, T.; Iwamoto, M.; Ido, T. (Inst. of Physical and Chemical Research, Saitama, Japan). Int. J. Appl. Radiat. Isotop.; 25: No. 9, 393-399(Sep 1974).

The excitation curves for the reactions of deuteron and ^{3}He-particle on neon to give ^{18}F and the thick target yield of ^{18}F for the reaction of tritons on oxygen were measured up to the deuteron and triton energies of 24 MeV and the ^{3}He-particle energy of 42 MeV. These three reactions, together with the reactions of ^{3}He-and α-particle on oxygen, were then compared with a view to the practical production of ^{18}F in various useful states. The ^{3}He-bombardment of a target system consisting of neon and water separated by a thin foil has proved to provide, simultaneously, anhydrous ^{18}F and aqueous ^{18}F, both in good yields. The triton bombardment can be regarded as the most valuable method for the activation analysis of trace oxygen. (auth)

10019 REMOVAL OF 1p AND 1s NUCLEONS FROM ^{6,7}Li. Kaellne, J.; Fagerstroem, B.; Sundberg, O.; Tibell, G. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). Phys. Lett., B; 52: No. 3, 313-316(14 Oct 1974).

Deuteron spectra have been measured for the reactions ^{6,7}Li(p,d) in the separation energy range $E_S = 0-50$ MeV. Two groups of peaks appeared which were identified as due to pickup of 1s and 1p neutrons on the basis of the extracted spectroscopic factors and the comparison made with (p,2p) data. The measured $(1s)^{-1}$

spectral functions were found to change with the momentum transfer of the reaction. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 38$

Refer also to abstracts 10000, 10001, 10013, 10039, 10044, and 10055.

10020 CROSS SECTIONS FOR THE PRODUCTION OF MASS–6 AND MASS–7 NUCLIDES IN THE PROTON–INDUCED SPALLATION OF ^{20}Ne. Panggabean, L.M.; Austin, S.M.; Laumer, H. (Cyclotron Laboratory and Physics Department, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 10: No. 4, 1605-1608 (Oct 1974).

Cross sections for proton–induced spallation of ^{20}Ne leading to nuclides with mass 6 or mass 7 were measured at proton energies between 30 and 40 MeV. Time–of–flight techniques were used for mass identification. (auth)

10021 ANALOG TRANSITIONS IN THE A = 30 SYSTEM. Kuhlmann, E.; Hanna, S.S. (Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. C 10: No. 4, 1593-1595 (Oct 1974).

The γ–ray decay of the 2^+, T = 1 state at E_x = 4.183 MeV in ^{30}P was investigated. A new branch (2 ± 1) % to the 0^+, T = 1 state at E_x = 0.677 MeV was found. The decay mode is discussed in terms of isospin and an estimate of the lifetime of this state is derived. (auth)

10022 E0 DECAY OF THE 3788–keV 0^+ LEVEL OF ^{30}Si. Warburton, E.K.; Alburger, D.E. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 10: No. 4, 1570-1571 (Oct 1974).

The branching ratio of the 0^+ state of ^{30}Si at 3788 keV for decay by e^+-e^- pair emission to the 0^+ ground state is measured to be $(2.7 \pm 0.4) \times 10^{-3}$. Combining this branching ratio with the previously measured measured lifetime of the state leads to an E0 matrix element of (0.054 ± 0.009) single-particle units. (auth)

10023 STUDY OF THE REACTION ^{26}Mg(p, $\alpha\gamma$)^{23}Na THROUGH α-γ ANGULAR CORRELATIONS. Prasad, R.; Hofmann, A.; Vogler, F. (Physikalisches Institut III der Universität Erlangen–Nürnberg, Erlangen, Germany). Phys. Rev. C 10: No. 4, 1577-1580 (Oct 1974).

In the reaction ^{26}Mg(p, $\alpha\gamma$) the angular distributions of the α particles leading to the ground state, first, second, and fourth plus fifth excited states, and absolute double differential cross sections for $(\alpha_1,\gamma_{1\to0})$, $(\alpha_2,\gamma_{2\to1})$, and $(\alpha_5,\gamma_{5\to2})$ have been measured at an average proton energy of 9.88 MeV. The emergent α particles were detected with a multidetector arrangement consisting of eight silicon surface–barrier detectors. For the coincidence measurements a Ge(Li) detector placed in the reaction plane was used for the detection of γ rays. It has been found that the averaged differential and double differential cross sections can be described with the Hauser–Feshbach theory. An additional correlation measurement has been done in order to check the symmetry predicted for compound–nuclear reactions. The measurements agree with the predicted symmetry. (auth)

10024 4^+ AND 6^+ CORE-EXCITED STATES IN ^{20}Ne. Fortune, H. T.; Greenwood, L. R.; Segel, R. E.; Erskine, J. R. (Argonne National Lab., Ill. (USA)). Phys. Lett., B; 52: No. 1, 51-53(16 Sep 1974).

Selective population of the 4^+ and 6^+ states at E_x = 9.04 and 12.16 MeV, respectively, in the ^{12}C(^{12}C, α)^{20}Ne reaction identifies those states as the 4^+ and 6^+ members of the first $K^\pi = 0^+$ core-excited band, whose lower members are the 0^+ state at 7.20 MeV and the 2^+ state at 7.83 MeV. (auth)

10025 ON A HIGHLY INHIBITED E1 TRANSITION IN ^{21}Ne. Pilt, A. A. (Oxford Univ. (UK). Nuclear Physics Lab.). Phys. Lett., B; 52: No. 1, 21-23(16 Sep 1974).

The highly inhibited E1 transition from the 2790-keV level in ^{21}Ne to the ground state is shown to arise from the isospin properties of the intrinsic states. The analogous transition in ^{23}Na is shown to behave normally. (auth)

10026 ELASTIC AND INELASTIC SCATTERING IN THE ^{16}O + ^{24}Mg SYSTEM. Siwek-Wilczynska, K.; Wilczynski, J.; Christensen, P. R. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., A; 229: No. 3, 461-470(9 Sep 1974).

Excitation functions for elastic and inelastic scattering of the ^{16}O + ^{24}Mg system at energies of the ^{16}O ions ranging from 47 MeV to 72 MeV and angular distributions of elastic and inelastic (2^+, 1.37 MeV) scattering at 60 MeV have been studied. The excitation functions exhibit a very distinct gross structure. The elastic scattering data have been analyzed within the optical model framework, and optical model parameters with energy-dependent real and imaginary potentials have been deduced. Inelastic scattering data have been analyzed with DWBA and coupled-channel codes. (auth)

10027 STUDY OF ^{29}Al WITH THE ^{26}Mg(α, pγ)^{29}Al REACTION. Ekstroem, P.; Tillman, J. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). Nucl. Phys., A; 230: No. 2, 285-301(23 Sep 1974).

Particle-γ angular correlation and DSA measurements with the ^{26}Mg(α, pγ)^{29}Al reaction were used to obtain spectroscopic information on ^{29}Al levels. Excitation energies, branching and mixing ratios and mean lifetimes were determined for a number of levels up to 6 MeV excitation energy. The following new J^π assignments were made: $J^\pi(2.22) = \frac{3}{2}^+$ and $J^\pi(3.18) = \frac{5}{2}^+$. In addition, several J^π limitations were inferred. The experimental results are compared with shell model calculations. (auth)

10028 STUDY OF THE REACTION ^{29}Si(d, n)^{30}P AND OF THE STRUCTURE OF ^{30}P. Uzureau, J.; Ardouin, D.; Avignon, P. (Nantes Univ., 44 (France)); Adam, A.; Duchemin, B. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Nucl. Phys., A; 230: No. 2, 253-270(23 Sep 1974). (In French).

The nuclear structure of ^{30}P was studied using the ^{29}Si(d, n)^{30}P reaction at deuteron energies of 6 and 8 MeV. Neutrons were detected with a time-of-flight spectrometer. Absolute differential cross sections of transitions to 26 states in ^{30}P up to 7 MeV excitation energy were analyzed with DWBA and Hauser–Feshbach theories to yield 1_p values. New spin and parity assignments and values of spectroscopic factors were obtained. For the positive-parity states, experimental data are compared to results obtained from recent shell model calculations. More complete shell model calculations were extended to some odd-parity levels which are often strongly populated in the ^{29}Si(d, n)^{30}P reaction. When comparison with experimental values is possible, the agreement is reasonable. (auth)

10029 INVESTIGATION OF THE ^{26}Mg(d, p)^{27}Mg REACTION. Meurders, F.; van der Steld, A. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). Nucl. Phys., A; 230: No. 2, 317-328(23 Sep 1974).

The angular distributions of 31 protons groups from the ^{26}Mg (d, p)^{27}Mg reaction were measured at E_d = 12.0 MeV with a split-pole magnetic spectrograph. Excitation energies were determined for 29 bound states. Three new levels were found. A DWBA analysis yields 1_n values for 19 levels; two different least-squares procedures are discussed for this purpose. The deduced spectroscopic factors are compared with various shell model calculations. (auth)

10030 COMPARATIVE SPECTROSCOPY WITH THE (d, τ) REACTION ON EVEN Ar ISOTOPES. Doll, P.; Mackh, H.; Mairle, G.; Wagner, G. J. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Phys., A; 230: No. 2, 329-342(23 Sep 1974).

The (d,τ) proton pick-up reactions on ^{36}Ar and ^{38}Ar were studied at an incident energy of 52 MeV. Differential cross sections were measured, and spectroscopic factors were extracted for transitions to 14 states of ^{35}Cl and 13 states of ^{37}Cl, respectively. Many new $\frac{5}{2}^+$ states and nearly the complete ld$_{5/2}$ strength were observed in both nuclei. The width of the ld$_{5/2}$ spectral distribution is appreciably smaller for the semi-closed shell nucleus ^{38}Ar than for ^{36}Ar and ^{40}Ar. The results are compared with those from the ^{40}Ar(d,τ) reaction and proton stripping reactions on each of the three argon isotopes. Recent shell model calculations proved to be well suited to describe excitation energies as well as spectroscopic factors for the low lying positive-parity states. Mirror relations were established for the nuclei ^{35}Ar and ^{35}Cl. In ^{37}Cl a weak component of a 1p proton hole state was observed at a separation energy of only 10 MeV. (auth)

10031 THE 2425 keV STATE IN ^{21}Na AS A SUBTHRESHOLD RESONANCE IN ^{20}Ne(p,γ)^{21}Na. Rolfs, C.; Winkler, H. (California Inst. of Tech., Pasadena (USA)). Phys. Lett., B; 52: No. 3, 317-320(14 Oct 1974).

The high-energy tail of the $J^\pi = \frac{1}{2}^+$, 2425-keV state in ^{21}Na, bound by 7 keV against proton decay, has been observed in the ^{20}Ne(p,γ)^{21}Na reaction at E_p = 0.5 – 1.5 MeV. The observed excitation function is consistent with a single-level Breit–Wigner shape with $\Gamma\gamma = 0.31 \pm 0.07$ eV at E_x = 2425 keV. (auth)

10032 LIGHT AND HEAVY ION TRANSFER REACTIONS AMONG LIGHT NUCLEI. Soerensen, B. (Niels Bohr Institutet, Copenhagen (Denmark)). Phys. Lett., B; 52: No. 3, 285-288(14 (14 Oct 1974).

A comparison is made between two transfer reactions involving the same target and final nuclei, ^{26}Mg and ^{28}Si. The (τ,n) and (^{16}O,^{14}C) ground-band reactions are considered, representing light-

and heavy-ion projectiles. Despite the rather complicated nuclear structure transition involved in these reactions, the spectroscopic features of the two reactions are very similar. In both cases inelastic transitions entail major contributions from multistep processes. (auth)

10033 GARVEY–KELSON MASS FORMULA IN THE S–D SHELL. Bassichis, W. H.; Ali, S. S. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.). Phys. Lett., B; No. 3, 282-284(14 Oct 1974).

A literal interpretation of the Garvey–Kelson mass formula is used to relate deviations from the simple predictions for certain sextuplets of nuclei. The large discrepancies between prediction and experiment for ^{25}Ne, ^{29}Mg, and ^{33}Si are, in this way, removed. (auth)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 10008, 10055, 10074, and 10128.

10034 (ANU-P-594) g-FACTOR OF THE 235 keV STATE IN ^{44}Sc. Dracoulis, G. D.; Foote, G. S.; Slocombe, M. G. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Oct 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The g-factor of the 235 keV, 2^- state in ^{44}Sc was measured by observing the time integrated perturbation of the de-exciting γ-ray angular distributions under the influence of an externally applied magnetic field. The result, $g = +0.29 \pm 0.07$ supports the assignment of this state as a member of the $K = 0$ rotational band. (auth)

10035 γ-RAY DEEXCITATION OF ^{50}Ti STATES IN THE REGION OF 4–MeV EXCITATION. Pronko, J.G.; Bardin, T.T.; Becker, J.A.; McDonald, R.E.; Poletti, A.R. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). Phys. Rev. C 10: No. 4, 1345-1349 (Oct 1974).

Nuclear properties of several ^{50}Ti states in the region of 4–MeV excitation were obtained using the ^{48}Ti(t, p)^{50}Ti reaction at a bombarding energy of $E_t = 2.9$ MeV. Angular correlations of γ rays in time coincidence with protons detected in an annular particle detector positioned near 180° were obtained using an array of five NaI(Tl) counters. Doppler–shift–attenuation measurements were also performed using a 20–cm^3 Ge(Li) counter for the detection of γ rays. Analyses of these data yielded lifetime, excitation energy, and branching ratio information for some ^{50}Ti excited states. A unique spin assigment of $J = 2$ was found for the 4.31–MeV state and the mixing ratio for the $4.31 \rightarrow 1.56$–MeV transition was found to be $\delta = -0.26 \pm 0.17$. Some of the measured excitation energies (keV) and lifetimes (psec) are: (3869.9 ± 2.3, $0.60_{-0.20}^{+0.45}$); (4150.4 ± 6.3, not measured); (4179.2 ± 4.2, ≤ 0.30); and (4310.7 ± 3.0, < 0.08). (auth)

10036 LIFETIMES OF LEVELS IN ^{56}Co FROM DOPPLER–SHIFT MEASUREMENTS VIA THE ^{56}Fe(p, n)^{56}Co REACTION. Barker, J.H. (Department of Physics, St. Louis University, St. Louis, Missouri 63103); Sarantites, D.G. Phys. Rev. C 10: No. 4, 1407-1413 (Oct 1974).

The decay properties of the levels in ^{56}Co up to 1720.12 keV have been carefully investigated via the ^{56}Fe(p, nγ)^{56}Co reaction at 7.3 MeV, using a Ge(Li) –NaI(Tl) anti–Compton spectrometer. Three new weak transitions from well established levels were observed. Using the Doppler–shift attenuation method the values of $0.48_{-0.15}^{+0.32}$, ≥ 1.1, $0.11_{-0.02}^{+0.03}$, $0.63_{-0.18}^{+0.36}$, $0.35_{-0.03}^{+0.05}$, ≥ 0.6, and $0.49_{-0.17}^{+0.51}$ psec were obtained for the lifetimes of the 576.47–, 829.60–, 970.25–, 1009.11–, 1114.48–, 1450.62–, and 1720.12–keV levels, respectively. The value of the stopping power of Ni, previously calibrated for Cu ions, was used for the stopping of Co ions in Fe in order to extract the lifetimes from the measured centroid shifts obtained in singles experiments. Limits for the B(E2) and B(M1) values of many transitions were deduced from the present lifetimes and branching ratios using previously reported limits for the multipole mixing ratios δ(E2/M1). The results are compared with recent shell model calculations and good agreement is observed. (auth)

10037 β DECAY OF ^{49}Cr. Tabor, S. L.; Fifield, L. K.; Young, K.C. Jr.; Zurmühle, R.W. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 10: No. 4, 1484-1487 (Oct 1974).

The spectrum of γ rays following the β decay of ^{49}Cr has been measured with a 65 cm^3 Ge(Li) detector. β–decay branches to the following states in ^{49}V were observed (log ft values in parentheses): ground state (5.6), 91 keV (4.9), 153 keV (4.7), 1514 keV (5.7), 1661 keV (6.0), 2182 keV (6.9), 2235 keV (6.6) and 2309 keV (7.1). β–decay branches to the last three states have not been previously reported. In contrast to an earlier β–decay experiment, β branches to the 748 ($3/2^+$), 1021 ($11/2^-$), and 1140 ($5/2^+$) keV states were not observed. (auth)

10038 REFRACTIVE BEHAVIOR IN INTERMEDIATE–ENERGY ALPHA SCATTERING. Goldberg, D.A.; Smith, S.M.; Burdzik, G.F. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. C 10: No. 4, 1362-1371 (Oct 1974).

We report on recent α–scattering experiments at 141.7 MeV using ^{40}Ca and ^{90}Zr targets. The results are compared with previous experiments on other nuclides at approximately the same energy and are used to illustrate phenomena occurring in intermediate–energy α scattering to which we have given the name "refractive behavior." All the elastic scattering differential cross sections exhibit the exponential–like falloff at large angles characteristic of nuclear rainbow scattering. The variation in the rainbow angle with A is found to be approximately linear. In each instance it is shown that, consistent with earlier predictions, it is the data beyond the rainbow angle which make possible the elimination of the discrete ambiguities in the optical potential: For each nucleus studied, only a single family of Woods–Saxcn optical potentials is found to fit the data. The real parts of the extracted potentials are characterized by well depths ranging from 108 to 118 MeV and volume integrals J/4A ranging from 297 to 352 MeV fm^3; hence they are more nearly three times the strength of nucleon–nucleus potentials at 1/4 the incident energy, rather than 4 times, as is frequently assumed. Systematic variations of the optical potentials with A occur primarily in the imaginary part of the potential and are greatest for the lighter nuclei; as A decreases, W and a' decrease, r_0' increases, and the volume integral of the real part of the potential increases. (auth)

10039 SELECTIVE POPULATION OF MAXIMUM–J STATES IN THE (d, α) REACTION AT 80 MeV. Frascaria, N.; Didelez, J.P.; Garron, J.P.; Gerlic, E.; Roynette, J.C. (Institut de Physique Nucléaire–91406 Orsay, France). Phys. Rev. C 10: No. 4, 1422-1428 (Oct 1974).

The (d, α) reactions on ^{40,44,48}Ca and ^{58}Ni have been studied using the 80 MeV incident deuteron beam of the Orsay synchrocyclotron. It was found that satisfactory distorted wave Born approximation fits can be obtained. The experimental angular distributions were structured and thus provide minimal ambiguity in the determination of the angular momentum transfer. The angular momentum matching conditions greatly favored large values for the angular momentum transfer. Together with the selectivity of the (d, α) reactions, it allowed the identification of 7^+ states in ^{38,42,46}K and ^{56}Co. The observation of 7^+ levels in ^{38,42,46}K gives a measure of the $f_{7/2}$ proton occupation number in the ground state of the target nuclei ^{40,44,48}Ca. An apparent enhancement of certain of the 3^+ states at high excitation energy was observed in ^{46}K and ^{56}Co and the relative 3^+, 7^+ separation was in qualitative agreement with a simple shell–model picture. (auth)

10040 THE (^{3}He, n) REACTION ON EVEN (f, p) SHELL NUCLEI AT 15, 18 AND 21 MeV. II. Evers, D.; Assmann, W.; Rudolph, K.; Skorka, S. J. (Muenchen Univ. (F. R. Germany). Sektion Physik); Sperr, P. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). Nucl. Phys., A; 230: No. 1, 109-140(16 Sep 1974).

The (^{3}He, n) reaction on even Ca, Ti, Ni isotopes and ^{64}Zn has been studied with a time-of-flight facility at incident energies of 15, 18 and 21 MeV. Angular distributions were measured and analysed using the DWBA. The $L = 0$ and some $L = 2$ transfers could be observed, but essentially no states with spin higher than 2 were seen. Only moderate agreement with the pairing-vibrational model for the $L = 0$ transfers and a transitional behavior from normal to superconducting is found for the (^{3}He, n) reaction on (f, p) shell nuclei. (auth)

10041 CORRELATIONS BETWEEN REDUCED NEUTRON AND RADIATIVE WIDTHS IN NEUTRON RESONANCES. Lubert, M.; Francis, N. C. (Knolls Atomic Power Lab., Schenectady, N. Y. (USA)); Block, R. C. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). Nucl. Phys., A; 230: No. 1, 83-97(16 Sep 1974).

A mechanism underlying the correlation between the reduced neutron and radiative widths for the chromium and nickel isotopes has been derived. This theory combines a channel together with a compound-nucleus component. The bound-state single-particle reduced widths for ^{57}Fe, ^{53}Cr and ^{61}Ni were obtained by fitting the cross-section and partial radiative width data from the (γ, n) experiments by using R-matrix neutron scattering phase shifts. The thermal (n, γ) cross sections for ^{56}Fe, ^{52}Cr and ^{60}Ni as well as the total radiative widths for resonances of several of these isotopes were obtained. The correlations between the neutron and total radiative widths are attributed to transitions to a few strong low-lying bound p-states which have large reduced widths. (auth)

10042 SUB-COULOMB NEUTRON TRANSFERS FROM ^{17}O ONTO ^{40}Ca, ^{44}Ca AND ^{48}Ca. Jones, G. D. (Liverpool Univ. (UK)); Durell, J. L.; Lilley, J. S.; Phillips, W. R. (Manchester Univ. (UK)). Nucl. Phys., A; 230: No. 1, 173-188(16 Sep 1974).

The reactions ^{48}Ca(^{17}O, ^{16}O)^{49}Ca, ^{44}Ca(^{17}O, ^{16}O)^{45}Ca and ^{40}Ca(^{17}O, ^{16}O)^{41}Ca have been observed at bombarding energies of 27, 27 and

28.5 MeV, respectively. The cross sections for transitions to levels in the final nuclei with predominantly $2p_{3/2}$ configurations were measured over the angular range 100–170°. The results have been analysed using a DWBA theory with Coulomb wave functions describing the entrance and exit channels. For a chosen wave function for the ^{17}O ground state, the analysis yields the rms radii of the $2p_{3/2}$ single-particle orbits in the odd Ca isotopes. With the use of a simple potential model the rms radii of the $1f_{7/2}$ orbits are determined within reasonable limits, and the sizes obtained, compared with the rms radii of the neutron excesses in the Ca isotopes as calculated from Coulomb energy differences. The latter estimates are significantly lower than the values suggested by the present experiments. (auth)

10043 LEVEL STRUCTURE OF ^{47}Ti FROM THE (d, p) REACTION IN ^{46}Ti. Chowdhury, M. S.; Sen Gupta, H. M. (Dacca Univ. (Bangladesh)). Nucl. Phys., A; 229: No. 3, 484-508(9 Sep 1974).

The reaction $^{46}Ti(d, p)$ is studied at 10 MeV by using the Aldermaston tandem Van de Graaff accelerator and a multichannel magnetic spectrograph. A total of 180 levels are observed up to an excitation of ~ 7.2 MeV, and the stripping angular distributions are analysed in terms of the DWBA theory of direct reactions by using the NL/FR optical-model potential. Spins, parities and spectroscopic factors are deduced for various levels. Summed spectroscopic factors and quasi-particle energies are obtained for shell-model states. Properties of low-lying levels in ^{47}Ti are compared with the MBZ and Coriolis coupling models and also with those of the isotonic nuclei ^{45}Ca and ^{46}Sc. (auth)

10044 CORRESPONDENCE BETWEEN ZERO ANGULAR MOMENTUM TRANSFER CROSS SECTIONS OF (^6Li, ^6He) REACTIONS AND THE GAMOW–TELLER STRENGTH. Wharton, W. R.; Debevec, P. T. (Argonne National Lab., Ill. (USA)). Phys. Lett., B; 51: No. 5, 451-453(2 Sep 1974).

The (^6Li, ^6He) cross sections on targets between ^6Li and ^{48}Ca have been measured. The cross section due to zero angular momentum transfer appears to be correlated with the known Gamow–Teller strength. The reaction mechanism sometimes is dominated by multistep processes. (auth)

10045 RECOIL-DISTANCE LIFETIME MEASUREMENTS IN ^{51}Cr, ^{53}Cr, ^{53}Mn AND ^{53}Fe. Engelstein, P.; Forterre, M.; Schulz, N.; Vivien, J. P. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). Nucl. Phys., A; 230: No. 2, 358-364(23 Sep 1974).

Levels in ^{51}Cr, ^{53}Cr, ^{53}Mn and ^{53}Fe were excited via (α, n) or (α, p) reactions. Using the recoil-distance method, mean-lives (in ps) were obtained for excited states (keV) in the residual nuclei: $^{51}Cr(2256) = 66 \pm 2$, $^{53}Cr(1536) = 21.5 \pm 3.5$, $^{53}Cr(2173) = 6.7 \pm 3.1$, $^{53}Mn(2564) = 20 \pm 8_{-6}$ and $^{53}Fe(1424) = 4.0 \pm 1.0$. Reduced transition probabilities calculated from these values are compared with the available theoretical values. (auth)

10046 EFFECTIVE INTERACTIONS AND CHARGES IN ^{58}Ni. Pandya, S. P.; Singh, B. P. (Physical Research Lab., Ahmedabad, India). Pramana; 3: No. 2, 61-73(Aug 1974).

The structure of the low lying states of ^{58}Ni was calculated in the shell model by assuming an inert ^{56}Ni core plus two valence nucleons in the $p_{3/2}$, $f_{5/2}$ and $p_{1/2}$ orbitals. The two-body matrix elements are first expressed in terms of seven radial matrix elements, and these are then parametrized to give best fit between the computed and the observed energies of the levels below 4 MeV. The wave functions obtained using these two-body matrix elements are used to study the concept of effective charges. It is found that a single effective charge is not sufficient to predict the B(E2) rates equally well for the thirteen known transitions for which experimental values are available. Assumption of state-dependent effective charges gives a far better agreement. An analysis using wave functions obtained with Kuo's two-body matrix elements also gives a similar result. (auth)

10047 STATIC QUADRUPOLE MOMENTS AND B(E2)(0 → 2) VALUES IN 2p–1f SHELL NUCLEI. Sharma, S. K. (International Centre for Theoretical Physics, Trieste (Italy)). Phys. Lett., B; 52: No. 3, 299-302(14 Oct 1974).

The quadrupole moments of the first excited states and the reduced transition probabilities for E2 transitions in even–even Ti, Cr, Fe, and Ni isotopes are calculated from the projected Hartree–Fock–Bogolyubov wave functions in the 2p–1f shell. The overall agreement between the calculated and experimental results is quite good. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 10013, 10040, 10041, 10047, 10066, 10067, 10070, and 10120.

10048 OSCILLATING FORWARD ANGLE CROSS SECTIONS FOR THE $^{60}Ni(^{18}O, ^{16}O)^{62}Ni_{g.s.}$ TRANSITION. LeVine, M.J.; Baltz, A.J.; Bond, P.D.; Garrett, J.D.; Kahana, S.; Thorn, C.E. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 10: No. 4, 1602-1604 (Oct 1974).

The yield of the $^{60}Ni(^{18}O, ^{16}O)^{62}Ni_{g.s.}$ reaction at an incident energy of 65 MeV has been measured to forward angles using a QDDD spectrometer. Predicted, strong oscillations in the forward angle differential cross section are indeed observed. The detailed shape of this angular distribution can be reproduced by distorted–wave Born–approximation calculations employing an optical potential more strongly absorbing in the nuclear interior, and more weakly absorbing at the nuclear surface than previously used. (auth)

10049 LIFETIMES OF THE FIRST TWO EXCITED STATES OF ^{66}Ga. Dietrich, F.S.; Hansen, L.F.; Koopman, R.P. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. C 10: No. 4, 1587-1589 (Oct 1974).

The 44– and 66–keV levels of ^{66}Ga have been excited by the $^{66}Zn(p, n)^{66}Ga$ reaction, and their decay γ rays timed with respect to the pulsed proton beam. The extracted half–lives are 17.3 ± 2.0 ns for the 44–keV level, and 15.4 ± 0.4 ns for the 66–keV level. (auth)

10050 NUCLEAR SPECTROSCOPY WITH THE $^{62}Ni(^7Li,^6He)^{63}Cu$ REACTION. White, R.L.; Kemper, K.W. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 10: No. 4, 1372-1380 (Oct 1974).

The levels of ^{63}Cu with $E_x \leq 2.51$ MeV have been studied with the $^{62}Ni(^7Li,^6He)^{63}Cu$ reaction at $E(^7Li) = 34$ MeV to test the usefulness of this reaction as a spectroscopic tool. Elastic scattering data were taken for the $^7Li + ^{62}Ni$ and $^6Li + ^{63}Cu$ systems and optical model parameters were extracted so that finite range distorted–wave Born–approximation (DWBA) calculations could be performed. The DWBA differential cross sections well reproduce the shapes of the data. The absolute spectroscopic factors are in excellent over–all agreement with previously published light–ion studies, indicating that the extracted ^6Li optical parameters are a reasonable approximation for the ^6He optical parameters and that the $^7Li \rightarrow ^6He + p$ spectroscopic factor is in good agreement with the theoretical value of Cohen and Kurath. In addition, this reaction permits a clear distinction between $p_{3/2}$ and $p_{1/2}$ final–state configurations when very forward angle data are taken. (auth)

10051 STRUCTURE OF ^{62}Zn AND ^{64}Zn THROUGH (p,t) REACTIONS AT 35 MeV. Hinrichs, R.A. (Department of Physics, State University of New York, College at Oswego, Oswego, New York 13126 and Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48823); Patterson, D.M. Phys. Rev. C 10: No. 4, 1381-1390 (Oct 1974).

Energy levels in ^{62}Zn and ^{64}Zn have been investigated via the (p,t) reaction at 35 MeV. Many new levels are reported up to an excitation energy of 5.3 MeV, with spin and parity assignments determined for most levels, including the 0^+ member of the two-phonon triplet in ^{62}Zn at 2.33 MeV. A comparison between the states populated in these two reactions is made. Standard distorted–wave calculations give reasonable agreement with the data. However, 3^- and 4^+ states cannot be unambiguously distinguished. (auth)

10052 CORIOLIS–COUPLING MODEL APPLIED TO ODD–NEUTRON NUCLEAR SPECTRA OF THE $1g_{9/2}$ SHELL. Heller, S.L.; Friedman, J.N. (Department of Physics, Polytechnic Institute of Brooklyn, Brooklyn, New York 11201). Phys. Rev. C 10: No. 4, 1509-1518 (Oct 1974).

A Coriolis–coupling model extended to include a residual pairing type interaction is applied to investigate the energy levels of low-lying states of the odd nuclei of the $1g_{9/2}$ shell ($73 < A < 87$). This deformed rotational treatment includes spectra of both parities originating from overlapping states of the N = 4 and N = 3 positive- and negative-parity shells. Single-particle energy levels and wave functions throughout a shell are computed using spin–orbit and well–flattening parameters $C = -0.26\hbar\omega_0$ and $D_{N=4,3} = -0.040\hbar\omega_0, -0.053\hbar\omega_0$, respectively, the latter values being consistent with $d_{5/2}$ parentage states of ^{79}Se (positive parity) and $f_{5/2}$ states of ^{83}Kr (negative parity). Inclusion of an extracore pairing interaction primarily introduces a multiplicative effective overlap which serves as a quenching factor to the strength of off–diagonal Coriolis coupling terms. All parameters in the analysis are taken from available experimental considerations. The rotational constant A and deformation β, in particular, are derived from the location of the first excited 2^+ state of the neighboring even–even nucleus and its observed E2 transition rate to the ground state. For each set of parameters both a single-particle and a Coriolis-coupling diagonalization are performed over an entire shell of 10 or 15 Nilsson states to obtain final negative- or positive-parity spectra and wave functions. The results of this essentially fixed parameter model are presented and compared with experimental determinations with which they are in substantial agreement. In general, the model favors a prolate description for the nuclei in this region. Energy excitation spectra are all in general agreement, and in particular: (a) ground-state spins and lowest-lying opposite-parity spins are always correctly predicted; (b) many otherwise anomalous low-lying and often ground-state 7/2⁺, 5/2⁺ spins are well predicted. The systematic reproduction of experimental spectra provided by the model points to the validity of a statically deformed interpretation of the odd-neutron nuclei of the $1g_{9/2}$ shell, in contrast to the purely spherical and vibrational approaches to which the region has been restricted in the past. (auth)

10053 STUDY OF ^{71,73,75,77}As WITH Ge(^{3}He, d) REACTIONS. Betts, R. R. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics); Mordechai, S. (Hebrew Univ., Jerusalem (Israel). Dept. of Physics); Pullen, D. J. (Lowell Technological Inst., Mass. (USA). Dept. of Physics); Rosner, B. (Technion-Israel Inst. of Tech., Haifa); Scholz, W. (State Univ. of New York, Albany (USA). Dept. of Physics). Nucl. Phys., A; 230: No. 2, 235-252(23 Sep 1974).

Studies of ^{71,73,75,77}As isotopes using Ge(^{3}He, d) reactions have enabled the identification of many previously unreported levels together with new spin-parity assignments. A comparison of the results with the predictions of the model of Scholz and Malik shows good agreement for both positive- and negative-parity states. (auth)

10054 TRANSITION RATES OF LOW-LYING STATES IN ^{89}Zr BY STUDY OF THE ^{86}Sr(α, nγ) REACTION. Bisping, J.; Ernst, J. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik); Rauch, F.; Seim, B. (Frankfurt Univ. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 230: No. 2, 221-234(23 Sep 1974).

By measuring the decay of low lying levels in ^{89}Zr populated in the ^{86}Sr(α, nγ) reaction at 0, 55, 90, and 135° with a Ge(Li) detector and stopping the recoils in a thick ^{86}SrO target, lifetimes were deduced by the DSA method. The results are: $\tau(1512) = 760 \pm 140$ fs, $\tau(1628) = 580 \pm 50$ fs, $\tau(1743) = 580 \pm 140$ fs, $\tau(1834) = 810 \pm 180$ fs, $\tau(1865) = 250 \pm 40$ fs, $\tau(1944) = 1070 \pm 160$ fs, $\tau(2100) = 110 \pm 20$ fs, $\tau(2102) = 150 \pm 20$ fs, $\tau(2220) = 35 \pm 10$ fs, $\tau(2298) = 125 \pm 20$ fs, $\tau(2388) = 190 \pm 60$ fs, $\tau(2568) = 145 \pm 55$ fs and $\tau(2756) = 510 \pm 280$ fs. The lifetimes for the levels at 1512, 1944, 2102, 2568 and 2756 have not been measured before, the others generally agree with previous data from the ^{89}Y(p, nγ)^{89}Zr reaction. The results obtained in the present and previous work are discussed with respect to the structure of ^{89}Zr states. (auth)

10055 THE INFLUENCE OF STRONGLY COUPLED PICKUP CHANNELS ON PROTON ELASTIC SCATTERING. Mackintosh, R. S. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Phys., A; 230: No. 2, 195-213(23 Sep 1974).

It is shown that the influence of strongly coupled deuteron channels on proton elastic scattering is large. The effect is to increase the total reaction cross section by an amount which is several times the pickup cross section. The effect is particularly large for light nuclei suggesting a reason for the breakdown of the folding model for these nuclei. Model calculations were carried out which make these results plausible in terms of the deuteron acting as a doorway for proton absorption. The effect on the real potential is considerable for lighter nuclei and consistently repulsive. Results are also presented concerning the applicability of DWBA for pickup and which illuminate the adiabatic model of Johnson and Soper. Uncertainty in very low energy deuteron propagation makes the observation of experimental effects at (p, d) threshold somewhat doubtful. (auth)

10056 GROUND-STATE DEFORMATIONS FOR NEUTRON-RICH NUCLEI IN THE A APPROXIMATELY 100 REGION. Faessler, A.; Galonska, J. E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); Goetz, U.; Pauli, H. C. (Basel Univ. (Switzerland)). Nucl. Phys., A; 230: No. 2, 302-316 (23 Sep 1974).

The deformation energy surfaces of neutron-rich Se, Kr, Sr, Zr, Mo, Ru, and Pd isotopes which are found as fission fragments were calculated utilizing the Strutinsky prescription with Saxon-Woods single-particle energies. The nuclear shapes are characterized by elongation, neck, and axial asymmetry. Contrary to previous results the present calculation indicates strong asymmetric deformations for the minima of the deformation energy surface. (auth)

10057 A STUDY OF LOW-LYING STATES OF ^{72}As USING THE ^{72}Ge(p, nγ)^{72}As REACTION. Mordechai, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)); Friedman, E.; Jaffe, A. A.; Nir, D.; Paul, M. (Hebrew Univ., Jerusalem (Israel)). Nucl. Phys., A; 230: No. 2, 343-352(23 Sep 1974).

Several low lying states of ^{72}As were studied via the γ-rays following the bombardment of ^{72}Ge by protons in the energy range 5.1 to 6.2 MeV. Gamma-ray spectra were obtained using a Ge(Li) detector, and gamma-gamma coincidences between this detector and a NaI crystal were also investigated. Besides the single previously known excited state at 46 keV, 12 additional excited states were determined in ^{72}As energies of 213, 242, 308, 317, 333, 343, 413, 438, 454, 512, 523 and (561) keV. The angular distributions of the γ-rays from the 213 and 242 keV levels were also measured, and the results analyzed using the compound nucleus statistical model. The excited states at 213 and 242 keV were found to have spins of (2) and 3 respectively. (auth)

Nuclear Properties and Reactions, $90 \leq A \leq 149$

Refer also to abstracts 10013, 10038, 10055, 10056, and 10066.

10058 (ORNL-4976, pp 1-31) NUCLEAR CHEMISTRY. Oct 1974.

In Chemistry Division annual progress report for period ending May 20, 1974.

Delayed neutron emission from the decay of neutron-rich alkali isotopes was studied; half-lives and delayed neutron emission probabilities for Li, Na, Rb, and Cs precursors are tabulated. The cross section for neutron radiative capture in S was measured from 25 to 1150 keV; neutron widths and strength functions were found, and resonance parameters are tabulated. In order to study energy levels of ^{59}Co, gamma spectra and directional correlations were measured for the decay of ^{59}Fe. The evaporation residue cross section in the reaction ^{107}Ag + ^{20}Ne was investigated at 163.5 MeV; the ratio of compound-nucleus cross section to total reaction cross section is shown. Angular momentum effects in the fission of the ^{153}Tb compound nucleus were studied; fission excitation functions from 70 to 120 MeV are shown for formation by ^{12}C and ^{20}Ne bombardment. The g factor of the first 2⁺ level in ^{126}Xe is being investigated. Fusion cross sections for ^{40}Ar on Ti, Ni, Cu, and Ag were measured (energies ranged from 115 to 189 MeV); radius and barrier-height parameters were extracted for the first three elements. Excitation functions are shown for the production of Pt isotopes from ^{144}Sm and Po isotopes from ^{166}Er by bombardment with Ar ions from 200 to 280 MeV; it is concluded that the mechanism is compound-nucleus formation with evaporation of alpha particles. Multinucleon-transfer reactions were studied; c.m. angular and kinetic energy distributions of ^{151}Dy produced from 282-MeV ^{40}Ar + ^{142}Nd are shown. The electron-capture branching ratio in ^{149}Dy decay was determined directly. Differences between Ar- and Kr-induced reactions leading to the same compound nuclei, ^{156}Er and ^{158}Er, were investigated; excitation functions are given. A Doppler-shift plunger device for measurement of picosecond lifetimes is described, as well as a computer program for correction of Doppler-shift recoil-distance data. Lifetimes and B(E2) values were measured for rotational states in ^{232}Th, ^{164}Dy, and ^{238}U by the Doppler-shift recoil-distance technique. Ground bands in ^{160,162,164}Dy were Coulomb excited with ^{20}Ne and ^{35}Cl ions. Anomalous nuclear rotational behavior in the rare earth region was studied; "backbending" plots are given for ^{160}Er, ^{164}Yb, ^{170}W, and ^{176}Os. Effects of the solar flare of August 1972 on cosmogenic radionuclides in samples from Taurus-Littrow were discussed. Primordial radioelement concentrations in rocks and soils from Taurus-Littrow are reported: values of the K/U mass ratio as a function of K concentration are shown. (28 figures, 7 tables) (RWR)

10059 ELLIPSOIDAL SHAPE PARAMETERS OF EVEN-EVEN NUCLEI IN THE RARE EARTH REGION WITH CONTINUUM MODEL. Deshpande, V. K.; Prakash, V. R. (Indian Inst. of Tech., Kanpur). Can. J. Phys.; 52: No. 18, 1750-1754(15 Sep 1974).

The rotational flow model applied to the ground state rotational band of even-even nuclei in the rare earth region, assuming spheroidal shapes, was extended to include ellipsoidal shapes. The higher K = 2 rotational band is also analyzed. The conditions for obtaining a rotational spectrum in the continuum model are explored. (auth)

10060 SEARCH FOR THE DECAY OF ^{96}Zr. Eichler, E.; O'Kelley, G.D.; Eldridge, J.S.; Ball, J.B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 10: No. 4, 1572-1573 (Oct 1974).

We used the Oak Ridge National Laboratory low-background γ-ray spectrometer in an attempt to measure the decay of ^{96}Zr. Less than 0.13 disintegration min^{-1} was observed from a sample enriched in ^{96}Zr; this corresponds to a $t_{1/2} \geq 3.56 \times 10^{17}$ yr and a log ft value of ≥ 21.6. (auth)

10061 INTERNAL CONVERSION COEFFICIENT MEASUREMENTS FOR TRANSITIONS IN ^{140}Cs FROM THE DECAY OF ^{140}Xe. Adams, J.P.; Wohn, F.K.; Talbert, W.L. Jr.; Schick, W.C. Jr.; McConnell, J.R. (Ames Laboratory—USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. C 10: No. 4, 1467-1474 (Oct 1974).

The internal conversion coefficients (ICC) of 18 transitions in the decay of ^{140}Xe have been measured by the normalized electron–to–γ–ray ratio method using Si(Li) and Ge(Li) detectors. Mass–separated sources of ^{140}Xe were obtained from the TRISTAN on–line isotope separator facility. The ICC were used to deduce the multipolarities of the transitions. Tentative spin–parity assignments have been made for 14 levels in ^{140}Cs from consideration of the transition multipolarities and log ft values deduced from the results of a previous γ–ray decay study. (auth)

10062 ELECTROMAGNETIC PROPERTIES OF THE 11/2$^-$ STATES IN ^{111}Sn AND ^{113}Sn. Brenn, R.; Bhattacherjee, S.K.; Sprouse, G.D.; Young, L.E. (Department of Physics, State University of New York at Stony Brook, New York 11790). Phys. Rev. C 10: No. 4, 1414-1421 (Oct 1974).

In order to study the core polarization effects in medium heavy spherical nuclei, the mean lives and g factors of the 11/2$^-$ states in ^{111}Sn and ^{113}Sn have been measured. The isomeric states were populated by the ^{111}Cd(α, 2n)^{113}Sn and ^{107,109}Ag(^{7}Li, 3n)^{111,113}Sn reactions with pulsed α and ^{7}Li beams. The nuclear spin precession in the 60 kG field of an on–line superconducting magnet was observed time differentially. The following values were obtained: ^{111}Sn(11/2$^-$, 979.6 keV): τ = 13.3(15) ns, g = −0.23(2); ^{113}Sn(11/2$^-$, 740 keV): τ = 118.5(25) ns, g = −0.235(4). The magnetic moments of the 11/2$^-$ states in ^{111,113,115,119}Sn and their near constancy as a function of mass number are reproduced by a first order M1 core polarization calculation using pairing model wave functions, experimentally determined energy denominators, and occupancy parameters. The strong reduction of the M2 rates for the $h_{11/2} \rightarrow g_{7/2}$ transition as compared to the single-particle estimate shows the destructive effect of the spin–isospin M2 core polarization. (auth)

10063 COMMENTS ON THE EFFECTIVE M2 AND E3 TRANSITION PROBABILITIES FOR THE 1$h_{11/2}$ SINGLE–QUASIPROTON STATES. Waroquier, M.; Heyde, K. (Institute for Nuclear Physics, Rijksuniversiteit Gent, Proeftuinstraat, 86, B–9000 Gent, Belgium). Phys. Rev. C 10: No. 4, 1548-1550 (Oct 1974).

It has been shown that in the evaluation of the M2 transition from the $J^\pi = (11/2)^-_{(1)}$ to the $J^\pi = (7/2)^+_{(1)}$ state in the odd–proton N = 82 isotones, the three–quasiparticle admixtures in the transition moment, are not negligible. (auth)

10064 PHOTON YIELD OF 148.9–keV GAMMA OF ^{123}Xe. Johnston, A.S. (Crocker Nuclear Laboratory and Department of Nuclear Medicine, University of California at Davis, Davis, California 95616). Med. Phys. 1: No. 5, 280-282 (Sept 1974).

A direct measurement of the photon yield of the 148.9–keV gamma of ^{123}Xe has been made. The value obtained: 48.0±1.0 photons of 148.9–keV emitted per 100 decays of ^{123}Xe. The advantage of the present method is that it is a direct measurement and does not rely upon conversion coefficient measurements in ^{123}Xe and the summing of many gamma intensities. The half life of ^{123}Xe was measured and found to be 2.23±0.02 h. (auth)

10065 THERMAL NEUTRON CAPTURE GAMMA RAYS FROM ^{141}Pr(n,γ)^{142}Pr REACTION. Sriramamurthi, K.; Srinivasa Rao, M.; Sastry, D. L. (Andhra Univ., Waltair, India). Curr. Sci. (India); 43: No. 23, 739-740(5 Dec 1974).

Thermal neutron capture gamma rays from the product nucleous ^{142}Pr were investigated in the 0 to 900 keV range with a scintillation spectrometer coupled to a 400 channel analyzer at the "CIRUS" reactor of Bhabha Atomic Research Centre, India. The energies and relative intensities of the observed gamma components were estimated and discussed. (auth)

10066 ENERGY SPECTRA OF DELAYED NEUTRONS FROM SEPARATED FISSION PRODUCTS. I. The Precursors ^{85}As, ^{87}Br, ^{134}Sn, ^{135}Sb, ^{136}Te and ^{137}I. Shalev, S.; Rudstam, G. (The Swedish Research Councils' Lab., Studsvik, Nykoeping, Sweden). Nucl. Phys., A; 230: No. 1, 153-172(16 Sep 1974).

This is the first of a series of articles on delayed neutron spectrometry, in which neutron spectra are analyzed for mass-separated isotopes. The theoretical basis is given for calculations of level densities, neutron energies and neutron emission probabilities. Delayed neutron spectra from the precursors ^{87}Br and ^{137}I are used to obtain a normalized set of level density parameters, which are then used to analyze the neutron spectra from ^{85}As, ^{134}Sn, ^{135}Sb and ^{136}Te. (auth)

10067 ^{90}Y IN THE CORE-COUPLING MODEL. Hoffmann-Pinther, P.; Adams, J. L. (Ohio Univ., Athens (USA)). Nucl. Phys., A; 229: No. 3, 365-386(9 Sep 1974).

The low-lying levels and wave functions of ^{90}Y are calculated using the core-coupling model. The ^{89}Y and ^{89}Sr spectra are first calculated using the model developed by Thankappan and True. In this model the 0^+ ground state and 2^+ first excited state of ^{88}Sr are coupled to single-particle proton or neutron states. These model interactions are then used as a basis for the Hamiltonian of ^{90}Y. A zero-range proton–neutron interaction is also included in the Hamiltonian for ^{90}Y. The calculated energy levels of ^{90}Y and spectroscopic factors for the ^{89}Y(d, p)^{90}Y reaction are found to be in good agreement with experimental data. The ten states calculated from the combining of the ground-state doublet 2^- and 3^- states with the 2^+ core state are found to have an interesting behavior. For each doublet state quintet, the lowest allowable spin state, 0^- or 1^-, is pushed up about 1 MeV in energy compared to the other four possible spin states. (auth)

10068 ABSOLUTE TRANSITION PROBABILITIES IN ^{130}Xe. Burde, J.; Eshhar, S.; Ginzburg, A.; Navon, E. (Hebrew Univ., Jerusalem (Israel)). Nucl. Phys., A; 229: No. 3, 387-396(9 Sep 1974).

Lifetime measurements of the excited states of ^{130}Xe were carried out by delayed coincidence measurements between the β spectrum of ^{130g}I and the conversion lines that de-excite the levels by using a double-lens coincidence spectrometer. The mean lifetimes of the 2362-keV and 536-keV levels were determined as τ = 13.5 ± 2 psec and 12.0 ± 3 psec, respectively. The sum of the mean lifetimes of the 1204-keV and 1944-keV levels was measured as 4.0 ± 1.6 psec. Conversion coefficients were measured for the most prominent transitions. The 2362-keV state was assigned as a $(\pi g_{7/2}, \pi d_{5/2})6^+$ two-quasi-particle configuration, and its de-excitation mode to the ground quasi-rotational band could be accounted for by a small amplitude admixture of the 6^+ rotational configuration. The present B(E2; $0^+ \rightarrow 2^+$) value for the 536-keV state is in excellent agreement with a pairing-plus-quadrupole calculation for spherical nuclei; on the other hand, the energy spacings in this nucleus can be reproduced by the asymmetric rotational model with the parameters μ = 0.60, γ = 24°. The predicted sum of the lifetimes for the 4^+ and 6^+ rotational states agrees with the result within the experimental errors. (auth)

10069 ^{114,116}Cd LEVEL STRUCTURE FROM THE (n, n'γ) REACTION. Gill, D. R.; Ahmed, N.; McDonald, W. J.; Neilson, G. C.; Elbakr, S. A.; van Heerden, I. J.; Dawson, W. K. (Alberta Univ., Edmonton (Canada). Nuclear Research Centre). Nucl. Phys., A; 229: No. 3, 397-416(9 Sep 1974).

The ^{114}Cd and ^{116}Cd nuclei have been studied using the (n, n'γ) reaction. Levels and their spins have been confirmed at 558 (2^+), 1134(0^+), 1210(2^+), 1284(4^+), 1365(2^+), and 1733(4^+) for ^{114}Cd and at 513(2^+), 1213(2^+), 1220(4^+), and 1381(0^+) for ^{116}Cd. Spin assignments have been made for some previously observed levels and for some new levels at 1843(1), 1861(0), 1865(1), 1959(1), and 2040(4) for ^{114}Cd and at 1283(0), 1644(2,3), 1917(0), 1953(0), 2120 (0,1), and 2243 for ^{116}Cd. (auth)

10070 STRUCTURE OF STATES IN THE MASS-90 REGION BY (p, p'γ) ANGULAR CORRELATION AT THE LOWEST $5/2^+$ ANALOGUE RESONANCES. Cue, N.; Plesser, I.; Vager, Z.; Wheeler, G. F. (Weizmann Inst. of Science, Rehovoth (Israel)). Nucl. Phys., A; 229: No. 3, 429-446(9 Sep 1974).

Angular correlations between inelastically scattered protons leading to the 2^+ and in some cases the 4^+ states of doubly even nuclei in the mass-90 region and subsequent $2^+ \rightarrow 0^+$ γ-rays were measured. Analog resonances corresponding to the lowest $5/2^+$ states of odd nuclei were observed. The data were analysed using a method which takes into account compound nuclear enhancement. Relative decay partial amplitudes of the analog resonances were deduced. (auth)

10071 DETERMINATION OF THE g_J -FACTOR AND THE MAGNETIC hfs INTERACTION CONSTANT IN THE $6^2P_{1/2}$-STATE OF ^{133}Cs BY OPTICAL DOUBLE RESONANCE IN A STRONG MAGNETIC FIELD. Abele, J.; Baumann, M.; Hartmann, W. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Phys. Lett., A; 49: No. 3, 205-206(9 Sep 1974).

The hyperfine structure of the $6^2P_{1/2}$-state of ^{133}Cs was measured by optical double resonance in a strong magnetic field. The magnetic hfs coupling constant and the g_J -factor were found to be: $a_{1/2}$ = 291.90(12) MHz; g_J = 0.66590(9). (auth)

10072 LEVELS AND TRANSITION PROBABILITIES IN ^{124}In AS OBSERVED IN THE DECAY OF ^{124}Cd. Fogelberg, B.; Nagarajan, T.; Grapengiesser, B. (Forskningsraadens Lab., Studsvik (Sweden)). Nucl. Phys., A; 230: No. 2, 214-220(23 Sep 1974).

The levels of ^{124}In, which are populated in the decay of ^{124}Cd, were investigated at the OSIRIS on-line facility by means of conversion electron and γ-ray spectroscopy. A γ-γ coincidence measurement combined with the deduced transition intensities permitted construction of a unique level scheme. The half-life of the 243 keV level of ^{124}In was determined to be 50 ± 6 ns by the method of delayed coincidence. (auth)

10073 DELAYED NEUTRON EMISSION FROM SEPARATED FISSION PRODUCTS. Rudstam, G.; Shalev, S.; Jonsson, O. C.

(The Swedish Research Councils' Laboratory, Studsvik, Nykoping, Sweden). Nucl. Instrum. Methods; 120: No. 2, 333-344(1 Sep 1974).

An on-line isotope separator has been used to extract selected delayed neutron precursors from a sample of thermally-fissioned ^{235}U. A high resolution neutron spectrometer was developed and used to determine the energy distribution of delayed neutrons from the precursors ^{87}Br, ^{88}Br, ^{136}Te, and ^{137}I, these being the major components of the first two delayed neutron groups. All the spectra were found to exhibit clear line structure. The fast neutron counting rate was determined for a wide range of other delayed neutron precursors. (auth)

10074 CALCULATION OF HIGHER MULTIPOLE RESONANCES. Krewald, S.; Speth, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Phys. Lett., B; 52: No. 3, 295-298(14 Oct 1974).

In the last few years, great progress in the investigation of high-lying collective states has been made by the use of improved experimental techniques. In addition to the well-known giant electric dipole resonances, giant resonances of higher multipolarity have also been detected. Microscopic calculations of these generalized giant resonances in ^{16}O, ^{40}Ca, and ^{90}Zr are presented within the renormalized RPA. A configuration space of two shells above and two shells below the Fermi surface is used, and a density-dependent particle–hole force has been taken. (NL)

10075 PARTICLE–VIBRATION COUPLING IN ^{107}Cd. Haeusser, O.; Donahue, D. J.; Hershberger, R. L.; Lutter, R.; Riess, F. (Muenchen Univ. (F. R. Germany). Sektion Physik); Bohn, H.; Faestermann, T.; v. Feilitzsch, F.; Loebner, K. E. G. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). Phys. Lett., B; 52: No. 3, 329-331(14 Oct 1974).

Mean lives (1360 keV $^{15}\!/_2{}^-$ and 933 keV $^{11}\!/_2{}^+$ states) and g-factors (845.5 keV $^{11}\!/_2{}^-$ and 2679 $^{21}\!/_2{}^+$ states) of yrast states have been measured in ^{107}Cd. The results support a particle–vibration coupling (PVC) rather than a rotation-aligned coupling (RAC) description of these states. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 9594 and 10059.

10076 (LA–5775-T) DIRECTIONAL CORRELATION TESTS FOR VIOLATION OF TIME-REVERSAL INVARIANCE IN GAMMA RAYS OF ^{180}Hf^m, ^{169}Tm, ^{175}Lu, AND ^{184}W. Murdoch, B. T. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1974. Contract W-7405-eng-36. 186p. Dep. NTIS $7.60.

Thesis. Submitted to Utah State Univ., Logan.

Experiments were performed to search for time-odd asymmetries in γ-γ directional correlations resulting from cascades $I_1 \to^{\gamma_1} I_2 \to^{\gamma_2} I_3$ in several radioactive sources. Searches were made for parity-even, time-odd terms of the form $(\vec{I}_1 \cdot \vec{k}_1 X \vec{k}_2)(\vec{k}_1 \cdot \vec{k}_2)$, where $\vec{k}_1$ and $\vec{k}_2$ are the momentum vectors of the two γ-rays, for the "regular" multipole components of the following highly hindered transitions: 501-keV (M2, $\widetilde{\mathrm{E2}}$, E3; ^{180}Hf^m), 198- and 177-keV (M1, E2; ^{169}Tm), 283-keV (E1, M2; ^{175}Lu), and 922-keV (E1, M2, E3; ^{184}W), each of which served as the initial (γ_1) radiation in a cascade. A search was also conducted for a parity-odd, time-odd contribution of the form $(\vec{I}_1 \cdot \vec{k}_1 \times \vec{k}_2)(\vec{I}_1 \cdot \vec{k}_2)$ in the "irregular" (parity-violating) $\widetilde{\mathrm{E2}}$ component of the ^{180}Hf^m 501-keV γ-ray. Nuclear spin polarization was produced cryogenically at T = 16 to 35 mK, with the sources introduced as impurities in magnetic hosts and external polarizing fields applied. Asymmetries were determined from comparison of coincidence rates with different spin directions, the γ-ray detectors remaining fixed. Limits on relative phase angles between the various multipole components of electromagnetic transition matrices were determined. Also, the time-odd components of the various transition matrices were evaluated as fractions of Weisskopf single-particle estimates, following arguments about the effects of nuclear-structure-related hindrances on time-odd components of nucleon-nucleon interactions which have previously been found valid in measurements of parity violation. These computations show components from 10^{-3} to 10^{-6} Weisskopf units, several orders more sensitive upper limits in several cases than have been established in previous TRIV experiments with γ-rays. In secondary experiments, the approach to microscopic magnetic saturation of the impurities Mn, Co, Ta, and Ir in polycrystalline iron at 20 mK were investigated by means of γ-ray angular distribution measurements, and it was found that applied external fields of 3-5 kOe were required to assure alignment of nuclear spins with applied magnetic field direction. Also, in another experiment, upper limits on the hyperfine nuclear magnetic fields at Zn, Zr, and Nb sites in the itinerant ferromagnet $ZrZn_2$ were determined by nuclear orientation. (auth)

10077 SPIN OF THE 295 keV LEVEL IN ^{151}Sm. Straume, O.; Burke, D. G.; Waddington, J. C. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 52: No. 17, 1648-1650(1 Sep 1974).

The angular distributions of gamma rays following Coulomb excitation of ^{151}Sm by 50 and 75 MeV ^{35}Cl ions were measured. The spin of the 295-keV level was uniquely determined to be I = $^5\!/_2$. (auth)

10078 PROPERTIES OF ^{156}Gd LEVELS POPULATED IN THE DECAY OF 15.2 DAY ^{156}Eu. Kluk, A.F.; Johnson, N.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Hamilton, J.H. Phys. Rev. C 10: No. 4, 1451-1466 (Oct 1974).

γ rays emitted in the radioactive decay of 15.2 day ^{156}Eu have been studied with large volume Ge(Li) detectors in both singles and coincidence modes. A total of 95 γ–ray transitions were observed in the ^{156}Eu decay, and 84 of these are placed in the ^{156}Gd level scheme, which consists of 26 excited states. Seven of these levels are assigned here for the first time. Many of the inconsistencies that have complicated the interpretation of previous work have been resolved in these studies. In particular, it has been possible in the extensive coincidence measurements to resolve several multiplets in the γ–ray spectrum and, therefore, to obtain accurate branching intensities for members of both the γ–vibrational band and two $K^\pi = 0^+$ excited bands. (auth)

10079 SEARCH FOR VIOLATION OF TIME–REVERSAL INVARIANCE IN ^{169}Tm AND ^{175}Lu γ RAYS. Murdoch, B.T.; Olsen, C.E.; Steyert, W.A. (Los Alamos Scientific Laboratory of the University of California, Los Alamos, New Mexico 87544). Phys. Rev. C 10: No. 4, 1475-1483 (Oct 1974).

Directional correlations of γ–γ cascades from polarized ^{169,175}Yb were measured and a difference technique used to search for time–reversal–invariance violating (TRIV) asymmetries. For the 198–110 keV cascade in ^{169}Tm a TRIV asymmetry $\mathcal{A}^{\mathrm{TRIV}} = (-18 \pm 15) \times 10^{-4}$ was determined, corresponding to a phase angle between the E2 and M1 multipole matrix elements of the 198 keV radiation given by $\sin\eta = +0.15 \pm 0.12$ with T–odd components of the E2 and M1 matrix elements equal to $+(1.8 \pm 1.5) \times 10^{-4}$ and $-(6.2 \pm 5.0) \times 10^{-3}$ of the Weissko pf estimates, respectively. Hypothetical interpretation of TRIV as a result of state mixing is discussed, giving the expectation value of the TRIV part of the interaction Hamiltonian as $+1.0 \pm 0.8$ keV. For the 283–114 keV cascade in ^{175}Lu, $\mathcal{A}^{\mathrm{TRIV}} = (+1.9 \pm 5.8) \times 10^{-4}$ was measured, with corresponding M2/E1 phase angle given by $\sin\eta = -0.17 \pm 0.5$ and T–odd matrix elements equal to -0.05 ± 0.16 and $+(2 \pm 7) \times 10^{-4}$ Weisskopf units for the M2 and E1 components, respectively. Similar measurements on the 177–131 keV cascade in ^{169}Tm yielded uncertain results due in part to a large precessional perturbation. However, treatment of TRIV in the 283 keV γ ray assumed due to state mixing is shown to result in the conclusion that a modestly sensitive measurement of the phase angle of the E2 with respect to the M1 matrix element would give a good test of the magnitude of the TRIV component of the relevant interaction potential. (auth)

10080 A TEST OF SIMULTANEOUS PARITY AND TIME REVERSAL VIOLATION IN γ-DECAY. Murdoch, B. T.; Olsen, C. E.; Rosenblum, S. S.; Steyert, W. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Phys. Lett., B; 52: No. 3, 325-328 (14 Oct 1974).

The time reversal properties of the anomalously large parity-violating E2 contribution to the 501-keV γ-ray from ^{180m}Hf are examined. The time-reversal violating out-of-phase contribution is found to be -0.7 ± 0.6 of the in-phase E2 component. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 10013, 10055, and 10095.

10081 (LA–5552) NEUTRON SCATTERING CROSS SECTION OF ^{197}Au. Hoffman, M. M.; Sanders, W. M.; Berzins, G. J.; Brown, L. J.; Phillips, D. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 157p. Dep. NTIS $7.60.

Neutrons from an underground nuclear explosion designated "Physics 8" were used to measure the neutron elastic scattering of ^{197}Au from 35 eV to 2 MeV. A lead and polyethylene moderator was used to convert the neutron energy distribution from the nuclear device to a spectrum better suited to the cross section measurements. The neutron energy was determined by time of flight over a 258.485-m-long path providing a resolution of approximately 1 ns/m. Values of the neutron scattering cross section at 40 and 90° from the beam direction were determined.

Scattering resonances were resolved up to 2 keV, and they show an average level spacing ($\bar{D}$) of 15.6 eV. (auth)

10082 SINGLE–NUCLEON TRANSFER REACTIONS INDUCED BY ^{11}B IONS ON ^{208}Pb: A TEST OF THE DISTORTED–WAVE BORN APPROXIMATION. Ford, J.L.C. Jr.; Toth, K.S.; Satchler, G.R.; Hensley, D.C.; Owen, L.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); DeVries, R.M.; Gaedke, R.M.; Riley, P.J.; Thornton, S.T. Phys. Rev. C 10: No. 4, 1429-1450 (Oct 1974).

A 100–μg/cm^2 thick ^{208}Pb target was bombarded with 72.2–MeV ^{11}B ions accelerated in the Oak Ridge isochronous cyclotron. Reaction products were detected at the focal plane of an Elbek spectrograph using a 60–cm long position–sensitive proportional counter. In addition to determining the position of the detected particle along the focal plane, the energy loss in the counter helped to identify the particle type. Angular distributions were measured for all four possible single–nucleon transfer reaction products, i.e., ^{10}Be, ^{10}B, ^{12}C, and ^{12}B. These reactions were found to excite single–particle or single–hole states in the heavy residual nuclei, though some groups corresponding to the light ions being left in excited states were also identified. A finite–range distorted–wave Born–approximation analysis including exactly the effects due to recoil was made of these differential cross sections with particular attention being paid to various uncertainties. The major uncertainties arise from the choice of potentials (especially in the exit channels) and of form factors for the bound nucleon before and after transfer. Except for the (^{11}B, ^{10}B) reactions, which suffer from an unfavorable matching between incoming and outgoing orbits, the predicted angular distributions were in good agreement with the data, with extracted spectroscopic factors close to expected values and to those obtained in other light- and heavy-ion experiments. The indication then is that these reactions are predominantly one–step processes, though there is some evidence of the need for other effects to be considered. (auth)

10083 WIDTHS OF ANALOG STATES IN HEAVY ELEMENTS FROM (p, n) SPECTRA. Fielding, H.W.; Schery, S.D.; Lind, D.A.; Zafiratos, C.D. (Nuclear Physics Laboratory, Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302); Goodman, C.D. Phys. Rev. C 10: No. 4, 1560-1564 (Oct 1974).

The (p, n) reaction on targets of ^{197}Au, ^{206}Pb, ^{207}Pb, ^{208}Pb, ^{209}Bi, and ^{232}Th has been studied to obtain the widths, reaction Q values, and selected cross sections of the isobaric analog of the ground state of these targets. Widths obtained are, respectively, 116 ± 35, 175 ± 25, 192 ± 25, 235 ± 35, 257 ± 35, and 273 ± 30 keV assuming a Breit–Wigner line shape for the analog resonance. These results support the disagreement of previous (p, n) measurements with (p, n$\bar{p}$) measurements for the widths of ^{208}Pb and ^{209}Bi. Results are shown to be sensitive to choice of resonance line shape and provide a possible explanation for discrepancies between (p, n) and (p, n$\bar{p}$) measurements. The need for a more precise theoretical understanding of the structure of unbound analog resonances is indicated. (auth)

10084 COMMENT ON THE POSSIBLE MEASUREMENT OF VACUUM POLARIZATION IN HEAVY ION SCATTERING. Roskies, R.Z. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 10: No. 4, 1565-1565 (Oct 1974).

Contrary to a claim by Rafelski and Klein, one cannot use nonrelativistic elastic heavy ion collisions to probe the large q^2 behavior of the photon propagator. (auth)

10085 AUTOIONIZATION IN THE BETA DECAYS OF ^{210}Bi AND ^{204}Tl. Pathak, B.P. (Department of Chemistry, Rensselaer Polytechnic Institute, Troy, New York 12181). Phys. Rev. C 10: No. 4, 1599-1601 (Oct 1974).

Autoionization accompanying β decays of ^{204}Tl and ^{210}Bi has been studied. The K– and L–shell autoionization probabilities for ^{204}Tl have been found to be $(1.06 \pm 0.03) \times 10^{-4}$ and $(19 \pm 1) \times 10^{-4}$, respectively. The K–shell autoionization probability for the ^{210}Bi has been obtained as $(1.21 \pm 0.05) \times 10^{-4}$. (auth)

10086 NUCLEAR RESONANCE FLUORESCENCE STUDIES OF LEVELS IN ^{206}Pb, ^{207}Pb, ^{208}Pb, AND ^{209}Bi BELOW ABOUT 5 MeV. Swann, C. P. (Franklin Inst., Swarthmore, PA). J. Franklin Inst.; 298: No. 4, 321-332(Oct 1974).

Capabilities of the resonance fluorescence technique are discussed. Specific reference is given to the study of ground state dipole and electric quadrupole transitions below about 5 MeV in ^{206}Pb, ^{207}Pb, ^{208}Pb and ^{209}Bi. It is suggested that many of the states observed in ^{207}Pb and ^{209}Bi arise from the weak-coupling of a $p_{1/2}$ neutron hole or an $h_{9/2}$ proton to collective levels of ^{208}Pb. (auth)

10087 REACTIONS ON ^{209}Bi INDUCED BY INTERMEDIATE ENERGY PROTONS AND THE EFFECT OF DIRECT REACTIONS. Miyano, K.; Sekikawa, M.; Kaneko, T.; Nomoto, M. (Niigata Univ. (Japan). Dept. of Physics). Nucl. Phys., A; 230: No. 1, 98-108 (16 Sep 1974).

Excitation functions and ranges of recoil nuclei in the ^{209}Bi(p,3n)^{207}Po, ^{209}Bi(p,4n)^{206}Po and ^{209}Bi(p,p3n)^{206}Bi reactions have been measured for incident energies from 18 MeV up to 52 MeV. It has been found that the recoil ranges in (p, p3n) reactions are rather shorter than those in (p, 4n) and that beyond $E_p = 40$ MeV the high-energy tail of the excitation function for (p, p3n) is roughly flat, in contrast to the decreasing tail for (p, 4n). A theoretical analysis of the excitation functions and of the nuclear recoil ranges has been made. It has been found that in (p, p3n) reactions the direct process plays a very important part in the reaction mechanism. It is also found that the reaction mechanisms of (p, 3n) and (p, 4n) reactions should be interpreted by means of an admixture of the equilibrium compound process and the pre-equilibrium decay process at bombarding energies up to 40 MeV, respectively, and that the direct process seems to appear at bombarding energies higher than these respective energies. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 8169, 8298, 10073, 10083, and 10129.

10088 SEARCH FOR A HEAVY ANALOG OF LEAD IN LEAD ORES AND MINERALS. Flerov, G. N.; Ter-Akop'yan, G. M.; Getskin, L. S.; Goncharov, G. N.; Popeko, A. G.; Skobelev, N. K.; Gvozdev, B. A.; Tsyb, P. P. (Joint Inst. for Nuclear Research Dubna, USSR). Yadern. Fiz.; 20: No. 4, 639-644(Oct 1974). (In Russian).

Search for spontaneous fission of a heavy analogue of lead is carried out in 60 various mineral formations, where an isomorphic co-crystallization of eka-lead is possible. Large proportional counters and neutron detectors were used. In most of the studied samples no abundant activity was detected. In some lead sulphide ores a weak activity of spontaneous fission was, perhaps, found. However various mechanical and chemical methods of separation and enrichment yield no positive result. Assuming that the half-life period of the superheavy element in view is 10^9 years, its contents in the investigated samples is no more than 10^{-13}–10^{-15} g/g. (auth)

10089 NUCLEAR ORIENTATION STUDIES OF ^{241}Am AND ^{255}Fm. Soinski, A.J.; Shirley, D.A. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 10: No. 4, 1488-1497 (Oct 1974).

Nuclei of ^{241}Am and ^{255}Fm were oriented in single crystals of neodymium ethylsulfate at temperatures down to 11 mK. Orientation was detected by α–particle angular distributions. The temperature dependences of these distributions were consistent with the lowest electronic states of these two actinide ions in the ethylsulfate lattice being similar to those of the corresponding lanthanide ions. Thus quadrupole orientation was observed in Am^{3+} ($5f^6$), as in Eu^{3+} ($4f^6$). In Fm^{3+} ($5f^{11}$) the orientation was magnetic and equatorial ($|B|>|A|$), as would be expected from the hyperfine interaction in Er^{3+} ($4f^{11}$). For ^{241}Am we report $P = -0.0033(6)$ cm^{-1}, and for ^{255}Fm, $|B| = 0.035(7)$ cm^{-1}. The Am^{3+} data are consistent with an antishielding constant of $\gamma_\infty \simeq -10^2$, in good agreement with theory, and a shielding factor $\sigma_2 = 0.7$, similar to the value for Eu^{3+}. The nuclear results showed that the s and d α–particle partial waves are in phase for the favored α–decay branch in each case. The relative phase of the g wave could not be determined. (auth)

10090 LEVELS IN ^{233}Th USING THE ^{232}Th(n, γ) REACTION. Kern, J.; Duc, D. (Physics Department, University of Fribourg, 1700 Fribourg, Switzerland). Phys. Rev. C 10: No. 4, 1554-1559 (Oct 1974).

A total of 112 γ rays of the reaction ^{232}Th(n,γ)^{233}Th have been observed with the Fribourg pair spectrometer in the energy range $2.48 < E_\gamma < 4.8$ MeV. The level scheme proposed in previous works has been extended. A value of 4786.35 ± 0.25 keV has been determined for the neutron binding energy in ^{233}Th. (auth)

10091 FISSION–NEUTRON MULTIPLICITY AND TOTAL PROMPT GAMMA–RAY ENERGY FOR RESONANCES IN ^{239}Pu. Weston, L.W.; Todd, J.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 10: No. 4, 1402-1406 (Oct 1974).

The fission–neutron multiplicity $\bar{\nu}$ and the total prompt γ–ray energy have been studied for the resolved resonances in ^{239}Pu between 10 and 170 eV. There was a weak correlation found between $\bar{\nu}$ and the spin of the resonances. There was a significant correlation between the total γ–ray energy and the spin of the resonance. These correlations can be explained by competition of the (n, γf) reaction with the (n, f) reaction in the $J = 1$ resonances which have a narrow fission width. (auth)

10092 ASYMMETRIC FISSION OF ^{236}U IN A SELF–CONSISTENT K–MATRIX MODEL. Kolb, D. (Yale

University, New Haven, Connecticut 06520); Cusson, R.Y.; Schmitt, H.W. Phys. Rev. C 10: No. 4, 1529-1547 (Oct 1974).

The phenomenological single−particle Hamiltonian of Meldner is rederived as a renormalized single−particle K matrix and is used to calculate the properties of ^{236}U on the fission path from the ground state to scission into asymmetric fragments. Substantial radial density fluctuations or "bubble configurations" are observed as well as a displacement of the neutron center of mass relative to that of the protons. It is also found that the presence of a deep minimum and saddle near the touching point can be observed for one of the parameter sets of the interaction. The parameters of our deformation and atomic number independent model were obtained by fitting to the experimental properties of ^{16}O, ^{40}Ca, ^{48}Ca, and ^{208}Pb and nuclear matter. The present results illustrate the importance of using a nonorthogonal two−oscillator basis as well as taking into account the properties of nuclear matter. (auth)

10093 ATTEMPTED COULOMB EXCITATION OF THE SPONTANEOUS−FISSION ISOMERIC STATE IN ^{239}Pu. Bemis, C.E. Jr.; Plasil, F.; Ferguson, R.L.; Gross, E.E.; Zucker, A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 10: No. 4, 1590-1592 (Oct 1974).

Attempts to Coulomb excite the 8.5 μsec spontaneous−fission isomeric state in ^{239}Pu with 100− and 117−MeV ^{20}Ne ions have led to negative results. A cross section upper limit of 3.2×10^{-34} cm^2, integrated over ^{20}Ne laboratory scattering angles 90 ° → 180 °, was determined. (auth)

10094 STUDY OF THE GIANT DIPOLE RESONANCE OF ^{232}Th AND ^{238}U USING ELASTIC AND RAMAN PHOTON SCATTERING. Bar-Noy, T.; Moreh, R. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Nucl. Phys., A; 229: No. 3, 417–428(9 Sep 1974).

Differential cross sections for elastic and Raman scattering of photons from ^{232}Th and ^{238}U targets were measured. Eight photon energies in the range 7.9−11.4 MeV were used and were obtained from thermal neutron capture in Fe, Cr, Cu and Ni. The angular distribution of the elastic- and Raman-scattered radiation from ^{232}Th were measured. The results are compared with calculations of the simple rotator model and the dynamical collective model of the giant dipole resonance after incorporating the effect of Delbruck scattering. (auth)

10095 USE OF ON-LINE ALPHA-SPECTROSCOPY FOR CROSS-SECTION DETERMINATION OF SPALLATION PRODUCTS. Molzahn, D.; Brandt, R. (Philips-Univ., Marburg, Ger.). J. Radioanal. Chem.; 21: No. 2, 461–472(1974).

From 7th radiochemical conference; Marianske Lazne, Czech. (Apr 1973).

The cross sections for production of alpha activities via spallation in the interaction of thorium with 600-MeV protons from the CERN Synchrocyclotron (ISOLDE beam) were measured by employing on-line techniques. Products with half-lives in the range $4\ s < T < 1$ month were determined. During the course of this investigation the existence of a 62-s isomer of ^{222}Ac was confirmed. (auth)

10096 MEASUREMENT OF THE ANGULAR CORRELATION BETWEEN L−M X-RAY CASCADES. Zalutsky, M. R.; Macias, E. S. (Washington Univ., St. Louis, Mo. (USA). Dept. of Chemistry). Phys. Lett., A; 49: No. 4, 285–286(23 Sep 1974).

The angular correlation between $L\beta_1$ and several M_4 x-rays of plutonium was measured with semiconductor detectors. The angular correlation coefficient obtained is $A_{22} = (8.5 \pm 1.5) \times 10^{-2}$. This value is compared with theory. (auth)

10097 MULTIPLICITY OF PROMPT NEUTRONS FROM SPONTANEOUS FISSION OF THE ISOTOPE ^{252}102. Lazarev, Yu. A.; Nefediev, O. K.; Oganessian, Yu. Ts.; Dakowski, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). Phys. Lett., B; 52: No. 3, 321–324(14 Oct 1974).

The average number of prompt neutrons, $\bar{\nu}$, emitted in the spontaneous fission of the isotope of element 102 with mass number 252 and a half-life of 2.4 s has been measured to be 4.15 ± 0.30 relative to $\bar{\nu} = 2.69 \pm 0.01$ for spontaneous fission of ^{244}Cm. (auth)

Nuclear Theory

Refer also to abstract 10044.

10098 (RL-74-121) GLAUBER MODEL AND UNITARITY CONDITION. Formanek, J. (Science Research Council, Chilton (UK). Rutherford Lab.). Jul 1974. 32p. Dep. NTIS (US Sales Only) $4.75.

The Glauber model is discussed from the point of view of unitarity condition. It is shown that the model amplitudes slightly violate the unitarity condition unless the longitudinal momentum transfers of all contributing processes are much smaller (in Lab) than a nucleon mass. The physical origin of this fact and its consequences are briefly indicated. (auth)

10099 VARIANT OF THE WENTZEL−KRAMERS−BRILLOUIN METHOD AND CALCULATION OF THE CRITICAL NUCLEAR CHARGE. Marinov, M. S.; Popov, V. S. (Inst. of Theoretical a and Experimental Physics, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 4, 1250–1262(Oct 1974). (In Russian).

A modification of the WKB method is proposed which consists in exclusion of centrifugal energy from the momentum p(r) and in a corresponding alteration of the constant γ in the quantization condition $\gamma = \gamma(l, \alpha)$, where l is the orbital moment and $V(r) \propto r^{-\alpha}$ for $r \to 0$. The accuracy of the approximation and application of the WKB method for a strong Coulomb field with a charge $Z > 137$ are considered in detail. (auth)

10100 PAULI CORRECTIONS FOR CORRELATED WAVE FUNCTIONS. Goldhammer, P.; Pintar, J.A. (Department of Physics, University of Kansas, Lawrence, Kansas 66045). Phys. Rev. C 10: No. 4, 1581-1583 (Oct 1974).

An exact prescription is given for taking reference spectrum wave functions and deriving correlated wave functions which properly adhere to the Pauli exclusion principle. (auth)

10101 VARIATIONAL CALCULATION OF THE ON− AND OFF−SHELL T MATRIX. Payne, G.L. (Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa 52242); Perez, J.D. Phys. Rev. C 10: No. 4, 1584-1586 (Oct 1974).

The use of a Schwinger−type variational principle for the evaluation of the two−body T matrix $T(p', p, E)$ is shown to be an efficient and accurate method both on and off the energy shell. Using standard trial functions all of the matrix elements for the Reid soft−core interaction can be determined by simple recursion relations, and the evaluation of the T matrix is reduced to solving a set of simultaneous equations. (auth)

10102 MULTICONFIGURATION HARTREE−FOCK METHOD APPLIED TO AN EXACTLY SOLVABLE MODEL. Das, T.K.; Coelho, H.T. (Departamento de Física, Universidade Federal de Pernambuco, Recife, Brazil). Phys. Rev. C 10: No. 4, 1574-1576 (Oct 1974).

Application of the multiconfiguration Hartree−Fock method to the exactly solvable Lipkin model is critically examined. (auth)

10103 RECENT RESULTS ON ENERGY−LEVEL FLUCTUATIONS. Bohigas, O. (Facultad de Ciencias, Universidad Autónoma de Madrid, Madrid, España); Flores, J.; French, J.B.; Giannoni, M.J.; Mello, P.A.; Wong, S.S.M. Phys. Rev. C 10: No. 4, 1551-1553 (Oct 1974).

We comment on the present theoretical status of the distant−neighbor spacing distributions in view of recent experimental results. In particular, we stress that both the Gaussian orthogonal and the two−body random Hamiltonian ensembles predict essentially identical spacing distributions for the highly excited part of the spectrum; this is true also for the other available measures. Thus the statistical analysis of spectrum fluctuations does not inform us about the two−body or multibody nature of the interaction. We point out also that, when due attention is paid to the variation of level density with excitation, the fluctuation pattern observed in the slow−neutron domain is found to extend throughout the entire spectrum. (auth)

10104 MICROSCOPIC CALCULATION OF NUCLEAR CORRELATIONS. Sauer, P.U. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. C 10: No. 4, 1505-1508 (Oct 1974).

The diagrammatic expansion of the two−body density $\rho\ (\vec{r}_1, \vec{r}_2)$ in the nuclear ground state is given through second order in the reaction matrix. The second−order diagrams are grouped into sets and all diagrams of a given set have to be computed together in order to preserve its normalization $\int d^3r_1\ d^3r_2\ \rho\ (\vec{r}_1, \vec{r}_2) = 1$. Microscopic calculations of nuclear correlations have usually violated this normalization constraint. (auth)

10105 COUPLING BETWEEN ROTATIONS AND VIBRATIONS IN NUCLEI. Caldeira, M.H.; Pascoal, H.; da Conceição Ruivo, M.; Silva, E.M. (Laboratório de Física, Universidade de Coimbra, Coimbra, Portugal). Phys. Rev. C 10: No. 4, 1519-1524 (Oct 1974).

A discussion is presented of the interaction between rotations and vibrations in nuclei, based on the generator coordinate method. As an example, a solvable model due to Moszkowski is studied. It is shown that the generator coordinate method describes adequately the dynamics of this type of motion, not only in the deformed zone, but also in the transition region, due to the softness of the system against deformations and to the Coriolis effect. (auth)

10106 OPTICAL−MODEL POTENTIAL IN NUCLEAR MATTER FROM REID'S HARD CORE INTERACTION. Jeukenne, J.; Lejeune, A.; Mahaux, C. (Theoretical Physics, University of Liège at Sart Tilman, B–4000–Liège I, Belgium). Phys. Rev. C 10: No. 4, 1391-1401 (Oct 1974).

We describe a method for the calculation of the leading term of a previously proposed low–density expansion for the self–energy of nucleons in nuclear matter. We compute the single–particle complex potential energy, the average binding energy per nucleon, the complex symmetry potential, and the symmetry energy. We use Reid's hard core nucleon–nucleon interaction and take a Fermi momentum $k_F = 1.4$ fm^{-1}. The calculated single–particle potential energy is compared with the phenomenological values of the optical–model potential in the inner region of a nucleus. The real part of our theoretical value is given by 56 − 0.3E (MeV) below E = 150 MeV, and changes sign at 200 MeV. The imaginary part rises from 2 MeV at low energy to about 20 MeV at E = 200 MeV. These features are in good agreement with experimental evidence. The average binding energy B per nucleon calculated with a self–consistent potential energy for the particle states above k_F is equal to −11 MeV. In the standard approach, with no potential energy for intermediate particle states above k_F, one finds −8.65 MeV. We also calculate the symmetry potential. At low energy, its real part is equal to 14 (N − Z)/A (MeV); it changes sign at 110 MeV. Its imaginary part is equal to 3.5 (N − Z)/A (MeV) at low energy, and rises to 8.5 (N − Z)/A (MeV) at 200 MeV. The symmetry energy is equal to 27.8 MeV. (auth)

10107 AUSTERN–SASAKAWA SCATTERING THEORY. Soper, P.J.R. (Department of Physics, University of Surrey, Guildford, Surrey, England). Phys. Rev. C 10: No. 4, 1282-1291 (Oct 1974).

The Sasakawa theory of scattering in its various generalized forms is reviewed in detail with particular emphasis on Austern's extension of the method to the iterative solution of coupled differential and integral equations. The relevance of these methods to physical applications is explained. Coester's convergence proof for the Sasakawa series is generalized to include distorted waves and coupled equations, and the convergence of the related Austern series is investigated. A numerical comparison between the Austern and Born series is made for elastic scattering from a central potential. In a model coupled–channel calculation of nuclear inelastic scattering, the Austern method is shown to be a very practical method of solution. (auth)

10108 POSSIBLE TEST FOR GROUND-STATE CORRELATIONS IN SUPERFLUID NUCLEI. Civitarese, O. (Univ. Nacional, La Plata); Peltier, S. M.; Plastino, A.; Hernandez, E. S. Lett. Nuovo Cim.; 11: No. 13, 596-598(30 Nov 1974).

It is suggested that electromagnetic-transition rates between excited states may strongly show the influence of ground-state correlations. The B(E2) value for the transition between a 4^+ and a 2^+ was evaluated for this model. The result obtained was $B(E2)_{\mathrm{correlated}} - B(E2)_{\mathrm{uncorrelated}}/B(E2)_{\mathrm{uncorrelated}} = 0.57$. It is noted that a percentage of 57% should be appreciable enough to be experimentally observed. If these results are an indication of what happens in more involved situations, then interband transitions may yield direct evidence of ground-state correlations in superconducting nuclei and should be subjected therefore to further study in more realistic cases. (JFP)

10109 SEMIQUANTAL APPROXIMATIONS TO HEAVY ION REACTORS. Broglia, R. A.; Landowne, S.; Malfliet, R. A.; Rostokin, V.; Winther, Aa. (Niels Bohr Institutet, Copenhagen (Denmark)). Phys. Rep.; 11: No. 1, 1-28(Jun 1974).

Generalizations of the semiclassical theory of heavy-ion reactions are studied in which the reaction amplitude associated with a given trajectory is interpreted as a partial wave reaction matrix element corresponding to the angular momentum of that trajectory. By summing these amplitudes with the correct quantum mechanical geometrical factors and phases, a semiquantal scattering amplitude is obtained which takes proper account of some of the interference and diffraction phenomena in heavy-ion reactions. The different role played by the absorption in the quantal and semiclassical descriptions in investigated. (auth)

10110 BOSON-LIKE EXPANSIONS WITHOUT BOSONS: APPLICATION TO SEVERAL EXACTLY SOLUBLE SHELL MODELS WITH COLLECTIVE FEATURES. Chattopadhyay, P. K.; Klein, A. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics); Krejs, F. (Washington Univ., Seattle (USA). Dept. of Physics). Nucl. Phys., A; 229: No. 3, 509-532(9 Sep 1974).

It is recognized that the generators of a Lie algebra can be divided into three sets $\{Y^\dagger, Y, Z\}$. The set $Y^\dagger$ acting on a reference state generates a basis, Y generating the dual basis; it follows that any Z can be expressed as a polynomial in the $Y^\dagger$ and Y. Examples of such expansions for the algebra SU(2) and R(5), as well as for the algebras of more realistic shell model problems, are presented. These expansions play an essential role in approximate and successful algebraic studies of two exactly soluble models: the SU(2) model of Meshkov, Glick, and Lipkin and an R(5) symmetric model of vibrations and rotations in a plane devised by the authors. (auth)

10111 CORE POLARIZATION AND COULOMB DISPLACEMENT ENERGIES. Auerbach, N. (Rutgers–The State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Nucl. Phys., A; 229: No. 3, 447-460(9 Sep 1974).

A systematic study of the core polarization correction to Coulomb displacement energies is carried out. A zero-range density-independent and density-dependent force is used to calculate this correction in the A = 16, A = 40, and A = 208 regions. It is found that the core polarization correction does not increase the Coulomb displacement energies and, therefore, cannot resolve the existing discrepancy between theory and experiment. Moreover, when the mean square radius of the excess neutron distribution is decreased, the core polarization correction to the Coulomb energy becomes attractive and cancels the gain resulting from the direct Coulomb term. Hence, it is concluded that the discrepancy cannot be resolved even when the excess neutron distribution has an anomalously small radius. It is also pointed out that when the core polarization term is added, the discrepancy is almost equal in mirror nuclei with a single hole in the N = Z core and those with a single particle ouside the same core. Evidently, additional charge asymmetric corrections are required to resolve the discrepancies in Coulomb displacement energies. (auth)

10112 DENSE BARYON MATTER CALCULATIONS WITH REALISTIC POTENTIALS. Bethe, H. A. (Laboratory of Nuclear Studies, Ithaca, New York, USA); Johnson, M. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Phys., A; 230: No. 1, 1-58(16 Sep 1974).

The equation of state for dense hyperonic matter is calculated from five potential interaction models. The form of the potential is the same as that of Reid, a sum of Yukawa functions, the coefficients of which are adjusted separately in each partial wave to fit experimental nucleon–nucleon data. The strong, short-range central repulsion dominates the equation of state at high density, so special care is taken to make the strengths of the repulsive term consistent with meson theory. A simplified version of the constrained variational technique of Pandharipande is used to calculate the energy versus density. The calculation is performed for neutron matter and a mixture of nucleons and hyperons, $M \leqq 1236$ MeV. The various interaction models produce a spread of about 30% in the equations of state, which are generally stiffer than the equation of state calculated from the Reid potential by Pandharipande. This difference arises because these models have a more realistic repulsion than Reid's potential. (auth)

10113 RESONANCE INVESTIGATIONS IN THE FRAMEWORK OF A UNIFIED THEORY OF NUCLEI. Teufel, A. G.; Wildermuth, K. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 230: No. 1, 70-82(16 Sep 1974).

Within a unified theory of nuclei, resonance formulae are derived which are valid for every kind of bombarding particle and and which contain the possible influence of direct reactions. The formulae are discussed from the viewpoint of parametrization of experimental results. Moreover, the influence of penetration effects on resonance reactions is discussed and illustrated by results of quantitative calculations. (auth)

10114 ACCURATE CALCULATIONS OF NUCLEAR DEFECT WAVE FUNCTIONS. Weng, W. T.; Kuo, T. T. S. (State Univ. of New York, Stony Brook (USA). Dept. of Physics); Ratcliffe, K. F. (State Univ. of New York, Albany (USA). Dept. of Physics). Phys. Lett., B; 52: No. 1, 1-4(16 Sep 1974).

A new method is developed for the accurate determination of the defect wave function χ. Examples are calculated for ^{4}He by using the Reid potential, and are found to exhibit characteristic differences from the reference spectrum approximation for χ. (auth)

10115 SOFT-CORE CORRELATIONS AND THREE BODY FORCES IN NUCLEAR MATTER. Blatt, D. W. E. (Sydney Univ. (Australia)); McKellar, B. H. J. (Melbourne Univ., Parkville (Australia). School of Physics). Phys. Lett., B; 52: No. 1, 10-12(16 Sep 1974).

It is shown that, when nucleon–nucleon correlations are taken into account by using correlation functions derived from the Reid soft-core potential, the contribution of three-body forces to the binding energy of nuclear matter is enhanced. The two-pion-exchange three-body forces contribute 6 MeV attraction. (auth)

10116 AN EQUATION OF STATE FOR NUCLEAR AND HIGHER-DENSITY MATTER BASED ON A RELATIVISTIC MEAN-FIELD THEORY. Chin, S. A.; Walecka, J. D. (Stanford Univ., Calif. (USA). Inst. of Theoretical Physics). Phys. Lett., B; 52: No. 1, 24-28(16 Sep 1974).

A model stress tensor for high-density matter based on a linearized relativistic quantum field theory is examined. The two coupling constants are fit to nuclear matter. Other properties of nuclear and neutron matter and neutron stars are then implied. (auth)

10117 ON A SIMPLIFIED EFFECTIVE NEUTRON-PROTON INTERACTION INCLUDING CORE-POLARIZATION EFFECTS FOR ODD-ODD DEFORMED NUCLEI. Boisson, J. P.; Ogle, W.; Piepenbring, R. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Phys. Lett., B; 52: No. 1, 29-30 (16 Sep 1974).

It is well known that the description of odd–odd deformed nuclei is not satisfactory if the usual one-parameter δ force is used as the residual neutron–proton interaction. In this letter it is shown that, by starting with a simple δ force, an improvement can be obtained which takes into account polarization effects of the core, as well as possible tensor and spin–orbit force effects, and which introduces only one additional parameter. This improvement is even better than that obtained with a finite-range central-plus-tensor force, which introduces four additional parameters. (auth)

10118 MICROSCOPIC FORM FACTOR CALCULATIONS FOR THE QUASIELASTIC (^{6}Li, ^{6}He) REACTIONS. Wharton, W. R.; Debevec, P. T. (Argonne National Lab., Ill. (USA)). Phys. Lett., B; 51: No. 5, 447-450(2 Sep 1974).

A simple procedure is presented for calculating microscopic form factors for quasielastic reactions which does not make use of a multipole expansion of the interaction potential. The form factor of the (^{6}Li, ^{6}He) reactions is studied to reveal its general properties. (auth)

10119 POLARIZATION–ANALYZING POWER THEOREM FOR (p,n) TRANSITIONS BETWEEN MEMBERS OF AN ISOSPIN MULTIPLET. Conzett, H. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Phys. Lett., B; 51: No. 5, 445-446(2 Sep 1974).

The approximate equality between the polarization and the analyzing power in the ^{7}Li(p,n)^{7}Be and ^{3}H(p,n)^{3}He reactions is shown to result from time-reversal invariance and charge-symmetry of the interactions responsible for transitions between nuclear states which are members of an isospin doublet. The argument is extended to include larger isospin multiplets. (auth)

10120 COMPETITION BETWEEN SIMULTANEOUS AND SUCCESSIVE TRANSFER PROCESSES IN THE TWO-NUCLEON TRANSFER REACTIONS INDUCED BY HEAVY IONS. Kammuri, T. (Osaka Univ., Toyonaka (Japan). Dept. of Physics). Phys. Lett., B; 51: No. 5, 442-444(2 Sep 1974).

It is demonstrated that the successive transfer process dominates over the simultaneous transfer in the two-nucleon transfer between heavy ions. The results of the DWBA analyses for the case of the ^{64}Ni(^{16}O, ^{14}C)^{66}Zn reaction are presented. (auth)

10121 THE EFFECTS OF DENSITY-DEPENDENCE AND EXCHANGE ON THE EQUIVALENT SHARP RADIUS OF THE REAL PROTON OPTICAL POTENTIAL. Srivastava, D. K.; Ganguly, N. K. (Bhabha Atomic Research Centre, Bombay (India). Variable Energy Cyclotron Project); Hodgson, P. E. (Oxford Univ. (UK). Nuclear Physics Lab.). Phys. Lett., B; 51: No. 5, 439-441(2 Sep 1974).

The real part of the proton optical potential is calculated by using the folding model with Green's strongly density-dependent nucleon–nucleon interaction. The results for a range of nuclei give, approximately, for the equivalent sharp radius for proton optical potential $R_v = 1.13A^{1/3} + 0.40$ without exchange and $R_v = 1.13A^{1/3} + 0.55$ with exchange. The additive constant is interpreted as the range of the hard core of the nucleon–nucleon interaction. (auth)

10122 CRITICAL COMPARISON OF MICROSCOPIC CALCULATIONS FOR A MODEL NEUTRON LIQUID. Shen, L. (Department of Physics, California State University at Fullerton, Fullerton, California 92634); Woo, C. Phys. Rev. D 10: No. 2, 371-373 (15 July 1974).

The calculated energy–density relation of a well–defined superdense neutron liquid model is compared with other microscopic calculations. All techniques except one give consistent results. This finding has an important bearing on the existence of solid cores in neutron stars. (auth)

10123 CURRENT STATUS OF THE RELATIVISTIC TWO-NUCLEON ONE-BOSON EXCHANGE POTENTIAL. Erkelenz, K. (Bonn Univ. (F. R. Germany). Inst. fuer Theoretische Kernphysik). Phys. Rep.; 13: No. 5, 191-258(Oct 1974). 140 refs.

The present status of the two-nucleon potential derived from the one-boson-exchange model, that is, the OBEP, is discussed in detail. A general investigation of the success, limitations and necessary extensions of this potential model is performed using the author's contributions to this subject as the framework of the paper. For that reason the OBEP is applied to the two-nucleon and infinite nuclear-matter system. The OBEP is represented, and all calculations are performed in momentum space. This makes possible the investigation of the influence of the important off-energy shell continuation of the potential due to covariant perturbation theory. In order to carry out the partial-wave projection of the quantities involved (both the two-nucleon and nuclear-matter quantities), the helicity state formalism is used as extended by the author to the system of six independent off-shell amplitudes. Relativistic effects, such as meson retardation and kinematical corrections of the nucleon motion, turn out to have appreciable effects. (auth)

10124 NON-LINEAR DENSITY DEPENDENCE IN LOW ENERGY KAON–NUCLEUS INTERACTIONS. Dillig, M.; Weise, W. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Phys. Lett., B; 52: No. 3, 257-260(14 Oct 1974).

The importance of effects non-linear in the nuclear density in low-energy kaon–nucleus interactions is investigated using a schematic picture for correlations between strange baryons and nucleons in connection with an analysis of the kaon self-energy in nuclear matter. Several ways of extrapolating the KN amplitude below threshold are employed. The results indicate that effects non-linear in nuclear density play a non-negligible role in low-energy kaon–nucleus scattering. (auth)

10125 INDUCED ASYMMETRIC DEFORMATION BY CORIOLIS ANTI-PAIRING AND ANGULAR MOMENTUM PROJECTION. Lin, L. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik); Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Phys. Lett., B; 52: No. 3, 261-263(14 Oct 1974).

A simplified method is suggested for the study of the Coriolis anti-pairing effect of the high-spin rotational states in strongly deformed nuclei. This method allows for small asymmetric deformations and includes exact angular momentum and particle number projection. The angular momentum projection requires only the intergration over one Eulerian angle, although small asymmetric deformations may be present. (auth)

10126 PERIODIC STRUCTURE AND STABILITY OF NUCLEAR MATTER. Migdal, A. B. (L. D. Landau Institute for Theoretical Physics, Moscow, USSR). Phys. Lett., B; 52: No. 3, 264-266 (14 Oct 1974).

The stability of π-condensate in nuclear matter is considered. It is shown that the periodic structure of the condensate field leads to a periodic modulation of the nuclear density. The influence of the condensation on nuclear properties is discussed. (auth)

10127 NUCLEAR FIELD THEORY AS A METHOD OF TREATING THE PROBLEM OF OVERCOMPLETENESS IN DESCRIPTIONS INVOLVING ELEMENTARY MODES OF BOTH QUASI-PARTICLES AND COLLECTIVE TYPE. Bes, D. R.; Dussel, G. G. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)); Broglia, R. A. (State Univ. of New York, Stony Brook (USA). Dept. of Physics); Liotta, R. (Niels Bohr Institutet, Copenhagen (Denmark)); Mottelson, B. R. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Phys. Lett., B; 52: No. 3, 253-256(14 Oct 1974).

It is shown that the graphical perturbation treatment of nuclear fields (particle–vibration theory) converges to the exact solution, at least in the case of schematic many-body problems. The corresponding rules as well as all the interaction vertices required to obtain this convergence are here presented. (auth)

10128 EFFECTS OF CHANNEL NON-ORTHOGONALITY IN (d,p) REACTIONS. Imanishi, B. (Nihon Univ., Tokyo. Dept. of Physics); Ichimura, M. (Tokyo Univ. (Japan). Coll. of General Education); Kawai, M. (Tokyo Inst. of Tech. (Japan). Dept. of Physics). Phys. Lett., B; 52: No. 3, 267-270(14 Oct 1974).

Coupled-channel calculations for (d,p) reactions were performed in which a strong coupling between the d and p channels were assumed. Reactions investigated were ^{16}O(d,p)^{17}O(2s) and ^{40}Ca(d,p)^{41}Ca(2p) at $E_d = 10.5$ MeV and the related (d,d) and (p,p) scattering processes. The nonorthogonality of the d and p channels was taken into account. The results of these calculations are presented and are compared with coupled-channel calculations neglecting the channel nonorthogonality and also compared with the DWBA and optical model calculations. (auth)

10129 TRANSPORT PHENOMENA IN MULTI-NUCLEON TRANSFER REACTIONS. Noerenberg, W. (Heidelberg Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 52: No. 3, 289-292(14 Oct 1974).

Transport phenomena are shown to be present in multi-nucleon transfer reactions. Fokker–Planck equations are derived from a master equation and successfully applied to the element and energy distributions of $^{40}Ar + ^{232}Th$. Transport coefficients are extracted from the cross sections. (auth)

10130 ON THE TEST OF MILLISTRONG CP-VIOLATION MODEL IN NUCLEAR REACTIONS. Nikolaev, N. N. (L. D. Landau Institute for Theoretical Physics, Moscow, USSR); Shmatikov, M. Zh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Phys. Lett., B; 52: No. 3, 293-294(14 Oct 1974).

The main aim of this note is to draw attention to the fact that there is a specific possibility of sensitive tests of the existence of the millistrong CP violation with $\Delta I = 1$ in nuclear reactions. It is proposed to verify the reciprocity relation in (p,α) or (p,d) reactions in the region of the isospin-forbidden compound nucleus levels L, where, in principle, the considerable enhancement of the T-odd amplitude is possible. (NL)

10131 ON THE EXISTENCE OF LEVEL–LEVEL CORRELATIONS IN NUCLEAR REACTIONS. Sevgen, A. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Phys. Lett., B; 52: No. 3, 306-308(14 Oct 1974).

A necessary and sufficient condition for the existence of level–level correlations in nuclear reactions is proved. The condition is that whenever any N_μ ($\mu = 1, \ldots, M$; M = the number of compound levels), defined such that $N_\mu \equiv \Gamma_\mu^{-1} \Sigma_c \; |\Gamma_{\mu c}|$, is greater than unity ($N_\mu \geq 1$), the system has level–level correlations, where Γ_μ and $\Gamma_{\mu c}$ are the total width and the partial width in channel c, respectively, of a compound level $|\mu\rangle$ with complex energy $\epsilon_\mu = E_\mu - \frac{1}{2} i\Gamma_\mu$. (NL)

10132 A MICROSCOPIC TREATMENT OF HEAVY ION SCATTERING AT SUBCOULOMB ENERGIES. Clement, D.; Kanellopoulos, E. J.; Wildermuth, K. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 52: No. 3, 309-312(14 Oct 1974).

Based on a microscopic nuclear theory which basically accounts for the Pauli principle, a simple equation for the elastic scattering of heavy ions with identical cores at subcoulomb energies is derived and is applied to the elastic scattering of α on ^6Li nuclei. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 8822, 8870, 8876, 9174, 9264, 9643, and 10141.

10133 (PEL-235) ELECTRON ENERGY-LOSS AND MULTIPLE-SCATTERING DISTRIBUTIONS BELOW 2 MeV. Vande Putte, D. W. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Apr 1974. 52p. Dep. NTIS (US Sales Only) $5.75.

The various electron energy-loss and multiple-scattering distributions below 2 MeV in any material are presented. The continuous slowing-down approximation, the Landau and Blunck–Westphal theories are discussed. The multiple scattering theories of Goudsmit–Saunderson and Molière are examined in the continuous slowing-down approximation. Physical assumptions and restrictions of these theories, as well as their relation to one another, are underlined. Computer codes for evaluating these probability densities are included. (auth)

10134 (UCID-16163) ASSORTED MEANS OF MULTI-GROUP PHOTON ABSORPTION COEFFICIENTS. Stone, S.; Tarter, C. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Nov 1972. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

In multifrequency radiation transport calculations it is customary to use some form of mean absorption coefficient and several means have been devised. Here the kinds of numerical differences which occur among the commonly used means are described. Attention is concentrated on frequency regimes where the absorption coefficient can be approximated by $K_\nu = K/\nu^3$. Using this form, analytic expressions were derived for the Rosseland, Planck, direct, and reciprocal means and were evaluated in various limiting cases. Those situations in which the choice of mean is most likely to influence the result of a transport calculation are discussed briefly. (MHR)

10135 (WASH-1229(74)) RADIATION PROTECTION ENROLLMENTS AND DEGREES. Enrollments, Fall 1973. Degrees Granted, July 1965–June 1973. (USAEC Division of Labor Relations, Washington, D. C.). Jul 1974. 28p. Dep. NTIS $4.50.

The following tables are included: (1) radiation protection degrees granted, 1966 to 1973, by institution; (2) enrollments and degrees in subfields by institution; (3) minorities, women, and foreign nationals, enrollments and degrees by schools; (4) radiation protection curriculum or option by institution, 1973, and (5) post-graduation placement or plan of radiation protection graduates (1972-1973). (MHR)

10136 Z_2 DEPENDENCE OF THE ELECTRONIC STOPPING POWER OF LOW-VELOCITY CHANNELLED HEAVY IONS. Pathak, A. P. (UKAEA Research Group, Harwell, Eng.). J. Phys., C (London); 7: No. 18, 3239-3244(21 Sep 1974).

Calculations have been made of the electronic stopping power of different metals for ^{42}K ions moving along $\langle 100 \rangle$ directions in bcc crystals and along $\langle 110 \rangle$ directions in fcc crystals. The model used is the same as that used recently in calculating the stopping power of a given target for different projectiles; namely that the incoming ion loses energy by transferring momentum to target electrons which scatter elastically from it when the ion velocity is low. The dependence on the atomic number Z_2 of the target is seen to come primarily from the difference in the effective density of the target electrons which is determined by crystal constants. The trend of the calculated results is compared with available experimental data. (auth)

10137 ANOMALOUS ENERGY LOSS AND STRAGGLING OF 24.8–MeV ELECTRONS THROUGH THIN SINGLE CRYSTALS OF Si AND Ge. Tomimasu, T.; Mikado, T.; Yamazaki, T. (Electrotechnical Laboratory, Tanashi, Tokyo, Japan). Phys. Rev. B 10: No. 7, 2669-2675 (1 Oct 1974).

Anomalous broadenings in straggling distributions of 24.8–MeV electrons are found along Si $\langle 100 \rangle$ and Ge $\langle 110 \rangle$ axial directions, and incident–angle dependence of these anomalies is studied around each axis. Additional broadening $\Delta\Gamma$ to the full width at half–height Γ of the straggling distribution reaches 7.7 keV ($\Delta\Gamma/\Gamma = 8.5\%$) along the axis of 0.2067–g/cm^2 Si and 11.0 keV ($\Delta\Gamma/\Gamma = 11.0\%$) along the axis of 0.2155–g/cm^2 Ge. These can be interpreted as a consequence of radiation loss associated with a large enhancement of coherent low–energy–photon emission. (auth)

10138 INFLUENCE OF IONIC CHARGE STATE ON THE STOPPING POWER OF 27.8– AND 40–MeV OXYGEN IONS IN THE [011] CHANNEL OF SILVER. Moak, C.D.; Datz, S.; Appleton, B.R.; Biggerstaff, J.A.; Brown, M.D.; Krause, H.F.; Noggle, T.S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). Phys. Rev. B 10: No. 7, 2681-2686 (1 Oct 1974).

In many cases, it has been assumed that the stopping power of an ion is not strongly influenced by its ionic charge because screening electrons would largely mask the effect of charge–state differences. Usually it is difficult to tell whether an ion moving through a solid is highly stripped but highly screened or less highly stripped and screened. Earlier experiments had demonstrated that fast prestripped oxygen ions are able to survive passage through crystal channels of ~ 1–μm length and more without electron capture or loss. An experiment to detect slight differences in screening which would cause small differences in the stopping powers of O^{8+}, O^{7+}, and O^{6+} ions has been performed with 27.8– and 40–Mev O ions in the [011] channel of a Ag crystal with 0.8–μm pathlength. The differences are not small. The stopping powers follow the simple relation $S = kq^2$. The result in this case indicates that dynamic screening by conduction electrons plays no significant role in equalizing stopping powers. (auth)

10139 PHYSICAL ASPECTS OF SUPERVOLTAGE x–RAY THERAPY. Bagne, F. (Dartmouth–Hitchcock Medical Center, Honover, New Hampshire). Med. Phys. 1: No. 5, 266-274 (Sept 1974).

The physical properties of the concepts frequently used in radiation dosimetry to compute dose are studied for high–energy x–ray beams. The dose in tissue is divided into total incident and phantom–scatter components. The incident beam includes the primary photons as well as the collimator scattering contribution. The phantom scattering is composed of back– and front–scatter functions. The former function is shown to have essentially zero effect on dose at 33– and 45–MV energy x rays. Characteristics of tissue–maximum–ratio (TMR) at high energies are investigated and TMR tables are provided. Contrary to the definition of TMR, this function is observed to depend on SSD. TMR curves are fitted with a semi–empirical function with a maximum deviation of 1%. Mathematical equations are derived for the computation of dose from TMR. The applicability of the equivalent square technique to high energy photons is examined and found to be adequate. Properties of percent depth dose are studied and a number of related phenomena are discussed. (auth)

10140 A COMPARISON OF CENTRAL–AXIS DEPTH–DOSE VALUES IN WATER AND TISSUE–EQUIVALENT LIQUIDS FOR ^{60}Co. Payne, W.H.; Waggener, R.G.; Levy, L.B.; Russell, J.R. (Radiology Department, The University of Texas Health Science Center, San Antonio, Texas 78284). Med. Phys. 1: No. 5, 277-279 (Sept 1974).

Water has long been used to develop depth–dose data for clinical use. Biological material differs from water physically and chemically. Using tissue–equivalent liquids for phantom materials, central–axis depth–dose values are found which are lower for ^{60}Co gamma rays than the corresponding values using water, perhaps significantly. (auth)

10141 STOPPING–CROSS–SECTION ADDITIVITY FOR 1–2–MeV $^4He^+$ IN SOLID OXIDES. Feng, J.S.; Chu, W.K.; Nicolet, M. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. B 10: No. 9, 3781-3788 (1 Nov 1974).

The stopping of 1–2–MeV α particles in five solid oxides, MgO, Al_2O_3, SiO_2, α–Fe_2O_3, and Fe_3O_4, has been investigated by measuring the ratios of the elastically–back–scattered–particle yields from two–layered metal–oxide and metal–metal targets. By applying a self–consistent analytical procedure, it is demonstrated that within the 2% sensitivity of the experiment, there is a unique set of five elemental stopping cross sections that is applicable to the pure metals and their oxides. When the effective stopping cross section of oxygen in these solids is calculated using the reported Mg, Al, Si, and Fe stopping cross sections, the resulting values are systematically (6–22) % lower than the value reported for gaseous O_2. (auth)

10142 α–PARTICLE STOPPING CROSS SECTION OF GOLD AND SILVER AS MEASURED FROM THICK TARGETS. Lin, W.K.; Matteson, S.; Powers, D. (Baylor University, Waco, Texas 76703). Phys. Rev. B 10: No. 9, 3746-3755 (1 Nov 1974).

Stopping cross sections of α particles in Au and Ag have been obtained for $0.3 \leq E_\alpha \leq 2.0$ MeV. The experimental method consists of measuring the energy spectra of α particles elastically scattered from thick targets. The experimental details as well as the method for extracting the stopping cross section from measured energy spectra are discussed. The results are found to be in good agreement with those previously obtained using thin targets. (auth)

10143 OPTICAL BREMSSTRAHLUNG OF A RELATIVISTIC PARTICLE AND THE EFFECT OF MULTIPLE SCATTERING ON COHERENT RADIATION. Pafomov, V. E. (Inst. of Nuclear Research, Moscow). Dokl. Akad. Nauk SSSR; 213: No. 4, 819–821 (1 Dec 1973). (In Russian).

The bremsstrahlung radiation in a vacuum medium is studied in the optical and radio regions. Formulas giving the spectral distribution of the intensity of the radiation at small variations in the permittivity from unity and within these limits its arbitrary dependence on frequency are given. The effect of multiple scattering on the Vavilov–Cherenkov scattering is examined. (JSR)

10144 COMMENTS ON "SPECTRA AND DOSE FRACTIONS OF MONOENERGETIC NEUTRONS PASSED THROUGH DIFFERENT SHIELDS AND THEIR APPLICATION FOR DOSE-METER EVALUATION". Heinzelmann, M. (Kernforschungsanlage, Juelich GmbH, Ger.). Health Phys.; 27: No. 4, 404-405(Oct 1974).

Comment is made on the paper "Spectra and Dose Fractions of Monoenergetic Neutrons passed through Different Shields and Their Application for Dose-Meter Evaluation". (Makra et al. Health Phys.; 26: 29 (1974)). The discrepancies which exist between calculation and measurement of the energy spectra behind a shield of a neutron generator installation are pointed out and possible sources of such discrepancies considered. It is considered that the percentage of intermediate neutrons ($0.5\ \mathrm{eV} < E_n \leq 100\ \mathrm{keV}$) of the dose rate equivalent can be overestimated behind the shielding of neutron generator installations. But for a thicker shielding and in the presence of scattered neutrons the percentage of intermediate neutrons of the total dose rate equivalent is so high that a measuring only with a Dennis–Loosemore counter gives too small values of the dose rate equivalent and therefore it is not to be recommended. (UK)

10145 CONVERSION OF BETA-RAY DOSE RATES MEASURED IN AIR TO DOSE RATES IN SKIN. Jennings, W. A. (National Physical Lab., Teddington, Eng.). Phys. Med. Biol.; 19: No. 5, 748-752(Sep 1974).

Recommendations are made for the factors to be used in the conversion of β-ray dose rates measured in air to those in tissue averaged over the range of depths from 5 to 10 mg cm^{-2} (critical depth for the skin). (UK)

10146 SPECTRUM PERTURBATION AND ENERGY DEPOSITION MODELS FOR STOPPING POWER RATIO CALCULATIONS IN GENERAL CAVITY THEORY. Janssens, A.; Eggermont, G.; Jacobs, R.; Thielens, G. (Ghent State Univ.). Phys. Med. Biol.; 19: No. 5, 619-630(Sep 1974).

A new theoretical model is introduced for the calculation of the absorbed dose in a cavity irradiated with x- or γ-rays. It provides a method for evaluating the electron spectrum in the cavity by means of data on transmission, energy degradation, and backscatter. Spencer's two-step model for energy deposition was modified. The results were fitted to the Burlin expression. This yielded a calculated value for the attenuation coefficient. (auth)

10147 PARTICLE RANGE AND ENERGY DEPOSITION IN MATERIALS CONTAINING VOIDS. Odette, G. R. (Univ. of California, Santa Barbara); Schwartz, D. M.; Ardell, A. J. Radiat. Eff.; 22: No. 4, 217-223(1974).

The manner in which voids affect both the range and the energy deposition of energetic charged particles in irradiated metals has been investigated. Calculations of energy deposition for 5 MeV Cu^{++} ions and 1 MeV protons incident on Fe indicate uncertainties in these quantities that increase with penetration distance. Mass density corrections adequately account for the presence of voids, except at the end of range where the contribution of void-induced straggling can be significant. The extension of the average range in these samples can be appreciable, depending upon the relationship between swelling and dose. (auth)

10148 NUCLEAR ENERGY LOSS AND SCATTERING OF SODIUM IONS PENETRATING A THIN LAYER OF CARBON. A Computer Study. Skoog, R.; Hoegberg, G. (Chalmers Tekniska Hoegskola, Goteborg). Radiat. Eff.; 22: No. 4, 277-286(1974).

The passage of 46 to 200 keV sodium ions through thin ($\leq 15.2\ \mu\mathrm{g/cm}^2$) carbon layers has been simulated using the Monte-Carlo technique. The angular distributions agree very well with those obtained by Meyer (Phys. Stat. Sol.; (b) 44: 253(1971)) in his theoretical work on plural and multiple scattering. The angular and thickness dependences of the nuclear stopping cross section are compared with the experimental results of Hogberg (Phys. Stat. Sol.; (b) 48: 829(1971)). The agreement is good. Nuclear energy loss distributions are given for three acceptance angles of the detection system. The influence of the acceptance angle on the nuclear stopping cross section is also studied. For a small acceptance angle distributions at some scattering angles are given. A simple relation between the nuclear energy loss and the angular halfwidth is found. (auth)

10149 ANGULAR AND SPECTRAL DISTRIBUTIONS OF THE INTENSITY OF SCATTERED GAMMA-RADIATION IN THE 20 keV and 6 MeV RANGE OF INITIAL ENERGIES. Sidneva, S. N.; Strelkov, A. S. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 164-165(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 135(Feb 1974).

The angular and spectral distributions of the intensity of scattered gamma radiation from a point isotropic source in an infinite medium consisting of air are calculated by making use of a statistical sampling method. The initial quantum energy was varied from 20 keV to 6 MeV. The distributions were obtained at distances of 1, 2, 3, 4, 6, and 8 mean free paths from the original radiation. The characteristics of the field of the scattered radiation which were found are the values intensity, averaged over the chosen interval of the variable (solid angle or energy), and adjusted to unit interval of the variable and to a unit quantum emergent from the source. (MHR)

10150 DOSE FIELD CALCULATIONS ON SMALL COMPUTERS. Chilingarov, K. M.; Denisenko, O. N.; Mardynskii, Yu. S.; Kozlov, V. A. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 19: No. 12, 43-47(Dec 1974). (In Russian).

The application of small computers in radiological institutions for the preparation of a dosimetric plan of therapeutic irradiation is discussed. The calculation program of dose fields of bremsstrahlung radiation from a betatron is described with the boundary energy of γ quanta of 25 MeV. (auth)

10151 ENERGY LOSS OF LIGHT IONS CHANNELING IN SILICON. Melvin, J. D. Pasadena, CA; California Inst. of Tech. (1974). 125p. University Microfilms Order No. 74-24,450.

Thesis (Ph. D.).

Experimental measurements of rate of energy loss were made for protons of energy 0.5 to 1.6 MeV channeling through 1 μm thick silicon targets along the $\langle 110\rangle$, $\langle 111\rangle$, and $\langle 211\rangle$ axial directions, and the $\{100\}$, $\{110\}$, $\{111\}$, and $\{211\}$ planar directions. A 0.05% resolution automatically controlled magnetic spectrometer was used. The data are presented graphically along with an extensive summary of data in the literature. The data taken cover a wider range of channels than has previously been examined, and are in agreement with the data of F. Eisen, et al., Radd. Eff. 13, 93 (1972). The theory in the literature for channeling energy loss due to interaction with local electrons, core electrons, and distant valence electrons of the crystal atoms is summarized. Straggling is analyzed, and a computer program which calculates energy loss and straggling using this theory and the Moliere approximation to the Thomas Fermi potential, V_{TF}, and the detailed silicon crystal structure is described. Values for the local electron density Z_{loc} in each of the channels listed above are extracted from the data by graphical matching of the experimental and computer results. Zeroth and second order contributions to Z_{loc} as a function of distance from the center of the channel were computed from $\nabla^2 V_{TF} = 4\pi\rho$ for various channels in silicon. For data taken in this work and data of F. Eisen, et al., Radd. Eff. 13, 93 (1972), the calculated zeroth order contribution to Z_{loc} lies between the experimentally extracted Z_{loc} values obtained by using the peak and the leading edge of the transmission spectra, suggesting that the observed straggling is due both to statistical fluctuations and to path variation. (Diss. Abstr. Int., B)

Radiation Protection Standards

Refer also to abstract 10287.

10152 DOSE EQUIVALENT AND ABSORBED DOSE. Rindi, A. (Univ. of California, Berkeley); Thomas, R. H.; Liden, K. Phys. Med. Biol.; 19: No. 5, 738-739(Sep 1974).

Confusion engendered by the recommended use of the same physical unit, 1 J kg^{-1}, for the expression of two differing but related physical quantities (dose equivalent, H, and absorbed dose, D) is expressed by the authors of the first letter. The reply in the second letter clarifies the relationship between the two quantities, while pointing out that some intellectual difficulties may be encountered in understanding that an absorbed dose, D, of 1 J kg^{-1} can give rise to a dose equivalent, H, of 10 J kg^{-1}; H is related to the presumed risk in radiation protection whereas D is not. It is therefore highly desirable that the unit for the quantity dose equivalent, H, should have its own special name, the rem; by definition 1 rem = 0.01 J kg^{-1}. Accordingly 1 rem is always physically equal to 0.01 J kg^{-1}. (UK)

10153 USEFULNESS OF INTERCOMPARISON STUDIES FOR THE IMPROVEMENT OF X-RAY DOSIMETRY. Broerse, J. J. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands); Puite, K. J. Phys. Med. Biol.; 19: No. 5, 732-734(Sep 1974).

The results of a second European Late Effects Project Group (EULEP) intercomparison study of the consistency of x-ray dosimetry results among fourteen Institutes are recorded, and compared with the earlier study performed in 1970 and 1971 involving 11 of these Institutes. The absorbed x-ray doses and dose distributions were measured using mouse phantoms, containing sets of thermoluminescent (TL) dosimeters (Con-Rad $^7\mathrm{LiF}$ powder), in the cages used for mouse irradiations at the participating Institutes. The data were then compared with those obtained from an exposure at a standardization laboratory. The results showed that the intercomparison project had induced a considerable improvement in dosimetry procedures (absolute dosimetry and exposure conditions) employed at the 14 Institutes co-operating within EULEP, although for a few Institutes further improvements should be made. (UK)

10154 RADIOLOGICAL UNITS. Loevinger, R. Phys. Med. Biol.; 19: No. 5, 735-738(Sep 1974).

Disagreement with the recommendation of the British Committee on Radiation Units and Measurements to use SI units for exposure (Phys. Med. Biol., 1973, 18, 732; Br. J. Radiol., 1973, 46, 731) is expressed, and the argument for the eventual elimination of the quantity exposure in radiation dosimetry is developed. It is suggested that SI derived units with special names for the quantities absorbed dose and activity could be adopted instead, with advantages of economy, convenience and safety. (UK)

10155 DOSE CONVERSION FACTORS FOR ELECTRONS. Matsuzawa, H. (National Inst. of Radiological Sciences, Chiba, Japan); Kawashima, K.; Hiraoka, T.; Greening, J. R. Phys. Med. Biol.; 19: No. 5, 744-748(Sep 1974).

Tabulated data (Radiation Dosimetry: Electrons with Initial Energies between 1 and 50 MeV, Report 21, International Commission on Radiation Units and Measurements, Washington, D. C., 1972) for the conversion of ionization measurements at any depth in water into actual absorbed dose are criticized by the authors of the first letter. The results of a theoretical treatment indicated that the published values of C_E (overall conversion factor in rad/R for electron beams in water) should be decreased by 3%. The reply in the second letter challenges the assumptions made in the development of the theoretical treatment. It is concluded that the use of a Lucite build-up cap with ^{60}Co radiation does not seriously impair the air-equivalence of an ionization chamber which was designed for such equivalence, and the published data (ICRU Report 21) may be utilized without modification. (UK)

10156 SPECIAL RADIOLOGICAL UNITS. Dunster, H. J. (National Radiological Protection Board, Harwell, Eng.). Phys. Med. Biol.; 19: No. 5, 739-741(Sep 1974).

The interrelationship of the special radiological units, the rem and the rad, is discussed. The problems encountered in the use of these units originate from confusion between quantities (dose equivalent H and absorbed dose D), and the units in which these quantities are expressed. The need for distinction between equations concerning units and those concerning quantities is emphasized. (UK)

Radiation Source Calibration and Standardization

Refer also to abstracts 8161, 8303, and 8890.

10157 ACCURACY OF WELL IONIZATION CHAMBER ISOTOPE CALIBRATORS. Hare, D. L.; Hendee, W. R.; Whitney, W. P.; Chaney, E. L. (Univ. of Colorado, Denver). J. Nucl. Med.; 15: No. 12, 1138-1141(Dec 1974).

Activities of calibrated samples of ^{99m}Tc, ^{131}I, and ^{197}Hg were measured in well ionization chamber isotope calibrators in use in 14 clinical nuclear medicine facilities. These measurements yielded estimated activities which varied significantly (frequently, 15 to 25%) from the calibrated activities of the samples. For the isotope calibrators examined in this study, calibration factors have been supplied to correct indicated activities to true activities. Extension of this service to nuclear medicine facilities outside of Denver is planned. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 10144, 10269, and 10366.

10158 (CERN-Trans-74-6) MEASUREMENT OF RETURN OUTPUT OF CHARGED PARTICLES. Britvich, G. I.; Grigor'ev, V. A.; Kimel', L. R.; Lebedev, V. N. Jun 1974. Translation By A. T. Sanders of IFVE-ORZ-73-19. 12p. Dep. NTIS (US Sales Only) $4.00.

The results are given of the measurements of the integral return output of charged particles from shielding, originating from a narrow high-energy particle beam impingeing at right angles on the surface of a shielding barrier. The measurements were carried out on the positive particle beam of channel 6 of the IHEP proton synchrotron. (MHR)

10159 TRANSMISSION OF GAMMA-RADIATION THROUGH TWO-SECTION CHANNELS WITH RECTANGULAR CROSS SECTION IN A CONCRETE SHIELDING. Erin, S. A.; Larichev, A. V. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 167-168(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 137(Feb 1974).

The transmission of γ radiation from pointlike isotropic ^{198}Au, ^{137}Cs, and ^{60}Co sources was studied on a model of a two-section channel bent at a right angle and situated in a concrete shield. (MHR)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 9647, 9931, 10197, 10456, 10457, and 10459.

10160 PHYSICAL INTERPRETATION OF WAVE MECHANICS. II. Janossy, L. (Central Research for Physics, Budapest). Found. Phys.; 4: No. 4, 445-452(Dec 1974).

Continuing the considerations given previously, the analysis of the Aharonov–Bohm effect is used to show that the hydrodynamical variables by which the quantum mechanical one-body problem can be represented are of direct physical significance. It is shown in a particular case that the final state of a system can be obtained from its initial state in a unique manner if both states are characterized by hydrodynamical variables. (auth)

10161 SIMULTANEOUS MEASUREMENT FROM THE STANDPOINT OF QUANTUM ESTIMATION THEORY. Helstrom, C. W. (Univ. of California, San Diego). Found. Phys.; 4: No. 4, 453-463 (Dec 1974).

The purpose of the simultaneous measurement of noncommuting quantum observables can be viewed as the joint estimation of parameters of the density operator of the quantum system. Joint estimation involves the application of a multiply parameterized operator-valued measure. An example related to the simultaneous estimation of the position and velocity of a particle is given. Conceptual difficulties attending simultaneous measurement of noncommuting observables are avoided by this formulation. (auth)

10162 COMPLEX ENERGIES IN RELATIVISTIC QUANTUM THEORY. Edmonds, J. D. Jr. (Oregon State Univ., Corvallis). Found. Phys.; 4: No. 4, 473-479(Dec 1974).

A new four-component spin-$\frac{1}{2}$ wave equation for ordinary mass is discussed. It is shown that this equation has a conserved current not easily identified with a transition probability, only pure imaginary energy states, and is covariant. A tachyon-like Klein–Gordon equation is satisfied by this equation, but rest states are explicitly constructed. (auth)

10163 POSITIVE ENERGY RELATIVISTIC EQUATIONS FOR ARBITRARY SPIN. Browne, S. (Duke Univ., Durham, N. C. (USA). Dept. of Physics). Nucl. Phys., B; 79: No. 1, 70-76(11 Sep 1974).

Dirac has recently given a relativistic wave equation for particles with mass m and spin zero, but which allows only positive energy solutions. Using the general classification of finite component relativistically invariant wave equations given by O'Raifeartaigh and Neiderer, Dirac's result is generalized for spin zero to arbitrary spin j. (auth)

10164 SKEPTICAL QUANTUM THEORY. Groenewold, H. J. (Rijksuniversiteit Groningen (Netherlands)). Phys. Rep.; 11: No. 5, 327-354(Jul 1974).

Successful applications of quantum mechanics have been extended over an impressive field beyond the domain of classical mechanics. There is a high degree of agreement about the application to micro-systems with few degrees of freedom under non-relativistic conditions; but outside the latter domain the use of quantum theory becomes questionable, and even inside this domain there is a high degree of disagreement about the foundations and the interpretation of quantum theory. At first sight it might appear queer that after some 45 years of a highly successful theory the quarrels about its very foundations are as ardent as ever. It appears less strange as soon as one realizes that foundations of theories are usually constructed or changed after the theory has been constructed or changed. The term foundation is just a misleading petrified metaphor. One fundamental controversial problem is that of the quantal measurement process, by which information from the micro-quantal object is transferred into a macro-classical part of the measurement apparatus, for instance a recorder. For a better understanding of this process, a connection must be found between the phenomenological macro-classical description and the formal quantal description of such macro-systems with many degrees of freedom. Apparently 45 years have not yet been enough to develop such a quantum statistical mechanics beyond the domain of elementary quantum mechanics. The author is optimistic that in the long run a solution for this and other relevant physical problems may be found, but is skeptical that agreement ever could be reached about various non-physical controversies, or that the latter would ever become of fundamental importance for physics. (NL)

10165 CLASSICAL ELECTRODYNAMICS OF A NONLINEAR DIRAC FIELD WITH ANOMALOUS MAGNETIC MOMENT. Rañada, A.F.; Rañada, M.F. (Departamento de Física Teórica, Universidad de Zaragoza, Zaragoza, Spain); Soler, M.; Vázquez, L. Phys. Rev. D 10: No. 2, 517-525 (15 July 1974).

The classical electromagnetic interactions of a nonlinear spinor field are studied in perturbation theory. When Pauli terms are included, the model describes with reasonable accuracy (within the assumed approximations) such properties of the nucleons as spin, charge, magnetic moment, and the proton mass. With no other information one can calculate the proton–neutron mass difference, which comes out of the wrong sign and is of the same size as in quantum electrodynamics. (auth)

10166 EXPERIMENTAL CONSEQUENCES OF OBJECTIVE LOCAL THEORIES. Clauser, J.F. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Horne, M.A. Phys. Rev. D 10: No. 2, 526-535 (15 July 1974).

A broad class of theories, called "objective local theories," is defined, motivation for considering these theories is given, and experimental consequences of the class are investigated. An extension of previous analyses by Bell and by Clauser et al., shows that predictions of objective local theories and of quantum mechanics differ, and that an experimental test of the entire family of objective local theories can be performed. The experimental requirements are given. Objective local theories satisfying a plausible, but experimentally untestable supplementary assumption are shown to be imcompatible with existing experimental data. (auth)

10167 ON INVARIANT SOLUTIONS OF THE KORTEWEG-deVRIES EQUATION. Shen, H.; Ames, W. F. (Iowa Univ., Iowa City (USA)). Phys. Lett., A; 49: No. 4, 313-314(23 Sep 1974).

Possible invariant (similar) solutions of the Korteweg-deVries (KdV) equation $u_t + uu_x + u_{xxx} = 0$ are studied by means of infinitesimal transformations of Lie theory. The permissible groups are constructed and the associated group invariants (similar variables) are obtained. Invariant solutions are shown to satisfy a third order nonlinear differential equation. (auth)

Quantum Field Theories

Refer also to abstracts 9734, 9739, 9740, 9756, 9757, 9759, 9777, 9780, 9791, 9834, 9840, 9861, 9862, 9867, 9881, 9924, 9930, 9938, 9954, 10084, and 10221.

10168 (COO-3065-99) COVARIANCE OF THE RARITA–SCHWINGER FIELD WITH QUANTIZED SCALAR FIELD INTERACTION. Hagen, C. R. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). 8 Aug 1974. Contract AT (11-1)-3065. 24p. (UR-498). Dep. NTIS $4.25.

The vector-spinor formulation of the mass m spin-$\frac{3}{2}$ field is extended to include a coupling to a scalar field ϕ through the replacement $m \to m + g\phi$. The commutation relations of the resulting system are determined and the customary absence of positive definiteness of the canonical anticommutators displayed. The generators of the transformations of the Poincaré group are determined together with their commutators with the canonical variables of the theory. It is seen that the system does indeed transform covariantly, thereby demonstrating that the appearance of indefinite metric need not imply the frequently inferred breakdown of Lorentz invariance. (auth)

10169 RENORMALIZATION AND INVARIANCE IN QUANTUM FIELD THEORY. Conference Held in Capri, Italy, July 1–14, 1973. Caianiello, E. R. (ed.). NATO Advanced Study Institutes Series, Series B, Physics, Volume 5. New York; Plenum Publishing Corporation (1974). 410p. (CONF-730745–). $28.00.

Separate abstracts were prepared for each of the 17 papers included. (JFP)

For abstracts of individual papers see: 9755, 9820, 9861, 9954, 10170–10181, and 10221.

10170 DIMENSIONAL RENORMALIZATION. Butera, P.; Cicuta, G. M.; Montaldi, E. (Univ., Milan). pp 1-13 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

The discussion of dimensional renormalization, a renormalization involving an analytic interpolation in the space–time dimension for renormalization of quantum field theories, covers renormalization of a general scalar graph and gauge symmetries. (JFP)

10171 NEW APPROACH TO DIVERGENT INTEGRALS. Caianiello, E. R. (Univ., Salerno, Italy). pp 15-27 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

A new approach to the problem of divergent integrals, used for particles and fields, is given in which it is shown that if the original definition of the Riemann integral through Darboux sums is suitably modified corresponding to a specified class of divergent integrands, then the new integral is convergent and yields the same result which one would expect from renormalization. This is done for one-dimensional functions. It is apparent that a mathematically complete theory of the proposed integration procedure would appear as a quasi-local measure theory as contrasted with the standard local theory. (JFP)

10172 BRANCHING EQUATIONS OF I AND II TYPE AND THEIR CONNECTIONS WITH FINITE EQUATIONS OF MOTION AND THE CALLAN–SYMANZIK EQUATION. Caianiello, E. R.; Marinaro, M. (Univ., Salerno, Italy). pp 29-44 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

Previous results are recalled and presented in the context of quantum field theory. The finite parts of the vacuum expectation values of the time-ordered products of the field and current operators and the finite form of the equations of motion are considered. The derivatives of the Green functions are defined with respect to the parameters which appear in the Lagrangian as well as their variations under an infinitesimal change of the regularization rule. It is shown that the Callan–Symanzik equations can be derived quite naturally with this formalism that gives also additional information on the structure of the coefficients which appear in them. (JFP)

10173 NELSON'S SYMMETRY AT WORK: THE INFINITE VOLUME BEHAVIOR OF THE VACUUM FOR TWO-DIMENSIONAL SELF-COUPLED BOSE FIELDS. Guerra, F. (Univ., Salerno, Italy). pp 45-59 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

A self-coupled field in two-dimensional space-time is considered in the framework of the constructive quantum field theory program. (JFP)

10174 PATH INTEGRALS AND GAUGE THEORIES. Lee, B. W. (State Univ. of New York, Stony Brook). pp 61-74 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

The basic idea involved in path integral quantization is described so that one can proceed to the quantization of gauge theories by this method. (JFP)

10175 RENORMALIZABLE MODELS WITH BROKEN SYMMETRIES. Lowenstein, J. H. (Max-Planck-Institut fuer Physik, Munich); Rouet, A.; Stora, R.; Zimmermann, W. pp 75-122 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

The discussion of renormalizable models with broken symmetries covers a general review of perturbative renormalization, the dynamics of renormalizable models in perturbation theory, exact and broken symmetries: renormalization effects, gauge invariant quantization of the Goldstone and Higgs models, and models with vanishing symmetric mass parameters. (JFP)

10176 GROUP THEORETICAL APPROACH TO CONFORMAL INVARIANT QUANTUM FIELD THEORY. Mack, G. (Univ., Bern). pp 123-157 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

Lectures are given on the question of the construction and properties of a nontrivial exactly conformal invariant quantum field theory. Structures reminiscent of dual resonance models are found and illustrated. This offers an example of how the geometry of space–time can affect and to some extent determine the structure of a theory of fundamental processes. (JFP)

10177 RECENT PROGRESS ON COMPUTATIONAL METHODS IN FIELD THEORY. Pusterla, M. (Univ., Padua); Turchetti, G. pp 219-223 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

Attention is given to some peculiarities that make the Pade method valid along the present line of research in field theory. The amplitudes of πN and NN interactions are discussed. (JFP)

10178 SHORT REVIEW OF SMALL-DISTANCE-BEHAVIOR ANALYSIS. Symanzik, K. (Deutsches Elektronen-Synchrotron, Hamburg). pp 225-245 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

The review of small-distance behavior analysis covers massive and massless ϕ^4 theory, exceptional momenta in ϕ^4 theory, eigenvalue considerations in ϕ^4 theory. (JFP)

10179 DIAGRAMMAR AND DIMENSIONAL RENORMALIZATION. 't Hooft, G. (CERN, Geneva). pp 247-262 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

Since few people object to the idea that the Feynman diagrams contain more truth than the underlying formalism, it seems only rational to abandon previous principles and use the diagrammatic rules as a starting point. The diagrammatic approach to quantum field theory is advertised. (JFP)

10180 SELF-CONSISTENT QUANTUM FIELD THEORY AND SYMMETRY BREAKING. Umezawa, H. (Univ. of Wisconsin, Milwaukee). pp 275-328 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

Lectures are given on the study of spontaneously broken symmetries presented in the terminology of quantum field theory. A rigorous derivation of these results is given in which use was made of the path-integral method. (JFP)

10181 PRESENT STATUS OF THE COMPUTING METHODS IN QUANTUM ELECTRODYNAMICS. Visconti, A. (Univ., Provence, Marseille). pp 329-366 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

An application of the renormalization theory to quantum electrodynamics is given, namely, the numerical computation of radiative corrections to electromagnetic processes. The physics of electrons and photons, preliminary steps toward an automated quantum electrodynamics, integration methods, symbolic programs and the LISP language, programs for the enumeration of Feynman graphs, automatic recognition of the convergence of divergent graphs and the problem of counter terms, algebraic reduction of Feynman graphs, and various theoretical and experimental results are presented. (JFP)

10182 STABILITY OF THE EIGENVALUE CONDITION FOR THE FINE–STRUCTURE CONSTANT α AND SHORT–DISTANCE BEHAVIOR IN STRONG INTERACTION. I. Manoukian, E.B. (Dublin Institue for Advanced Studies, Dublin 4, Ireland). Phys. Rev. D 10: No. 6, 1883-1894 (15 Sept 1974).

The short–distance behavior of quantum electrodynamics in the presence of neutral–meson theory with pseudoscalar–pseudoscalar coupling is studied without closed fermion loops. It is then shown that in the single–closed–fermion–loop contribution to the renormalized photon self–energy part the Adler–Baker–Johnson eigenvalue condition for the fine–structure constant α remains unaltered. The effective strong coupling vanishes at very high energies and is simply expressed in terms of well–known parameters. An alternative type of solution to the above problem is also discussed (in an appendix) which, however, is not physically and technically very attractive for various mentioned reasons. (auth)

10183 STABILITY OF THE EIGENVALUE CONDITION FOR THE FINE–STRUCTURE CONSTANT α AND SHORT–DISTANCE BEHAVIOR IN STRONG INTERACTION. II. Manoukian, E.B. (Dublin Institute for Advanced Studies, Dublin 4, Ireland). Phys. Rev. D 10: No. 6, 1894-1901 (15 Sept 1974).

In the preceding paper, we have made a preliminary study of the short–distance behavior of quantum electrodynamics in the presence of neutral–meson theory with pseudoscalar–pseudoscalar coupling. We have learned in particular, by an elementary summation procedure, that in the single–fermion–loop contribution to the renormalized photon self–energy part, the Adler–Baker–Johnson eigenvalue condition for the fine–structure constant α, $F^{[1]}(x)\,|_{x=\alpha} = 0$, remains unaltered. We extend our results, in the single–fermion–loop context, to the pion self–energy part. As a consequence of the vanishing of the effective strong coupling at high energies, $\pi^0-\pi^0$ scattering graphs are finite and no ϕ^4 counterterm is required. We finally infer from the above work that the photon self–energy part in the multiloop contribution is asymptotically finite at the eigenvalue $[F^{[1]}(x)\,|_{x=\alpha}=0]$ independently of the value of the strong coupling. The point $x = \alpha$ is the assumed (infinite order) zero of the single–loop electromagnetic–current–correlation functions in mass–zero pure electrodynamics. (auth)

10184 HARTREE APPROXIMATION IN RELATIVISTIC FIELD THEORY. Schnitzer, H.J. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 10: No. 6, 2042-2046 (15 Sept 1974).

The large–N limit of $\lambda\phi^4$ theory with O(N) symmetry is derived by functional methods. Since the method does not require the cumbersome, detailed analysis of Feynman graphs, it should make possible the study of more complicated theories in the many–field limit. (auth)

10185 LEE MODEL AND SOURCE THEORY: A NEW METHOD OF CALCULATION. Dittrich, W. (Institut für Theoretische Physik der Universität Tübingen, Tübingen, West Germany). Phys. Rev. D 10: No. 6, 1902-1907 (15 Sept 1974).

Schwinger's source theory is employed to present a new approach to the Lee model. Topics discussed include causal analysis and space–time extrapolation, relativistic and nonrelativistic V–particle propagation function (single–spectral form), and V–particle decay. The technical advantages of source methods are indicated; unlike previous authors, we derive a completely finite theory, i.e., the conventional mass– and charge–renormalization procedure becomes obsolete. (auth)

10186 INFRARED BEHAVIOR IN TWO DIMENSIONS. Yildiz, A. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 10: No. 6, 1796-1799 (15 Sept 1974).

Infrared behavior of the photon Green's function is analyzed and it is shown that two dimensional quantum electrodynamics is free from severe infrared divergencies only in the case of a massless electron. The results of the perturbative approach as well as Wilson's scale invariance are analyzed by means of the renormalization–group method while the massless electron model is studied as a special case. (auth)

10187 NONPERTURBATIVE EFFECTIVE POTENTIAL FOR $\lambda\phi^4$ THEORY IN THE MANY–FIELD LIMIT. Schnitzer, H.J. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 10: No. 6, 1800-1822 (15 Sept 1974).

A $\lambda\phi^4$ theory of self–interacting boson fields with O(N) symmetry is considered. A nonperturbative method is developed to compute the effective potential, which becomes exact in the large–N limit. The stability of the vacuum and possible spontaneous symmetry breakdown of the theory are studied in this limit. The existence of a local minimum requires $0 < 1 + N\lambda)^{-1} 96\pi^2$, which may be either a true bound, or an indication of the breakdown of the N^{-1} expansion. The function β (λ) that appears in the Callan–Symanzik equations is calculated in the large–N limit of the massless theory without reference to a perturbation expansions in λ. It is observed that the presence of a nontrivial zero of β (λ) is a necessary condition for a spontaneously broken symmetry in the massless theory. On this basis, it is shown that β (λ) is unlikely to have a nontrivial zero. The leading–logarithm approximation to the effective potential is discussed within the above framework. (auth)

10188 FIELD THEORY OF RELATIVISTIC STRINGS. II. LOOPS AND POMERONS. Kaku, M.; Kikkawa, K. (Department of Physics, The City College of the City University of New York, New York, New York 10031). Phys. Rev. D 10: No. 6, 1823-1843 (15 Sept 1974).

In a previous paper we showed how to construct the field theory of relativistic strings, which is an entirely new kind of field theory, one based on quantizing along multilocal strings. We showed how to write down the Lagrangian, canonical commutation relations, and all tree amplitudes. In this paper we extend our previous results by (1) completing the graph counting for loops and showing that it reduces to the usual multiloop graphs and to the usual φ^3 counting, (2) demonstrating that Pomeron contributions must be added to our master Lagrangian if we are to preserve duality and crossing symmetry, (3) giving explicit matrix elements for Reggeon–Pomeron and Pomeron–Pomeron interactions, (4) giving a mechanism for shifting masses by summing over all Reggeon–Pomeron direct transition graphs, and (5) commenting on the relationship between the Shapiro–Virasoro model and quantized gravity. (auth)

10189 SCATTERING OF GAUGE BOSONS IN SIXTH ORDER AND NONRENORMALIZABILITY OF MASSIVE YANG–MILLS THEORIES. Mohapatra, R.N.; Sakakibara, S.; Sucher, J. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 10: No. 6, 1844-1853 (15 Sept 1974).

We consider the unitarity relation in order g^6 for the canonically quantized massive Yang–Mills theory. The three–particle intermediate–state contribution to the absorptive part of $T_{22} = T(W_a + W_b \rightarrow W_c + W_d)$ is reexpressed in terms of the absorptive parts of Feynman diagrams constructed using only "soft" propagators $-g_{\mu\nu}/(k^2-m^2)$ and $1/(k^2-m^2)$. The vertices which appear in this decomposition of Abs T_{22} are the usual ones which occur in order g^4, together with two new vertices of dimension five which couple a W to three ghost particles; these vertices are similar to those found by Veltman in his study of radiative corrections to the W propagator. It is shown that, as a consequence, the Feynman rules proposed recently by Hsu and Sudarshan for a quantized massive Yang–Mills theory do not yield a unitary S matrix. Our result is in harmony with Boulware's formal argument that such theories are not renormalizable. (auth)

10190 INVESTIGATIONS IN TWO–DIMENSIONAL VECTOR–MESON FIELD THEORIES. Segrè, G. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Weisberger, W.I. Phys. Rev. D 10: No. 6, 1767-1777 (15 Sept 1974).

We study several field theories in one space and one time dimension. Among them are a neutral vector meson with and without mass coupled to fermions and a massive self–coupled Yang–Mills field. For the former we discuss methods of solving the field theory and for the latter we attempt to establish its nonrenormalizability. (auth)

10191 EIKONAL MODEL WITH COVARIANT RECOIL IN RELATIVISTIC QUANTUM FIELD THEORY IN TERMS OF A CORRELATION EXPANSION. Matsson, L. (Institute of Theoretical Physics, FACK, S–402 20 Göteborg 5, Sweden). Phys. Rev. D 10: No. 6, 2010-2026 (15 Sept 1974).

A technique to derive covariant recoil to the eikonal model in relativistic quantum field theory is developed. Recoil is defined relative to the rectilinear–path approximation which gives the eikonal model. It appears in terms of a partially factorizable correlation expansion, where the first term is noncorrelated and is the usual eikonal model. The second term displays pair correlations, etc. By correlation here we mean dynamical correlation. Kinematical correlations due to four–momentum conservation are of course superimposed everywhere. We first consider soft recoil, and then generalize to the hard recoil, without introducing any cutoff. The technique is developed here for a scalar ϕ^3–type theory but it is general enough to be extended to, for example, quantum electrodynamics and scalar electrodynamics. (auth)

10192 CORRELATION EXPANSION IN SCALAR ELECTRODYNAMICS. Matsson, L. (Institute of Theoretical Physics. FACK, S–402 20 Göteborg 5, Sweden). Phys. Rev. D 10: No. 6, 2027-2037 (15 Sept 1974).

The recoil to the eikonal model in scalar electrodynamics is derived. We then make use of our generalization of Low's theorem, which in an earlier paper was derived for soft recoil due to real-photon emission to infinite order in the coupling constant. Here, we generalize this further to yield hard recoil due to virtual exchanged photons as well. Recoil is defined relative to the straight–line–path approximation which we know gives the eikonal model. The recoil appears in terms of a correlation expansion where the first term, which is noncorrelated, is the usual eikonal model. A second result is that this gives a better and more explicit alternative to a Bethe-Salpeter ladder amplitude, since our ladder includes all criscrosses. (auth)

10193 A SPIN–1/2 POSITIVE–ENERGY RELATIVISTIC WAVE EQUATION. Staunton, L.P. (Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). Phys. Rev. D 10: No. 6, 1760-1767 (15 Sept 1974).

A relativistic wave equation which describes a particle having mass m, spin 1/2, and only positive–energy eigenvalues is presented. The theory apparently evades the conditions which prevented minimal coupling to electromagnetism in the spinless positive–energy theory of Dirac. A more general method for reducing the Klein–Gordon operator is pointed out. (auth)

10194 FINITE QUANTUM ELECTRODYNAMICS. Pradhan, T. (Saha Institute of Nuclear Physics, Calcutta, India 700009); Lahiri, A. Phys. Rev. D 10: No. 6, 1872-1882 (15 Sept 1974).

It is shown that the ultraviolet divergences encountered in the lowest–order perturbation calculations of quantum electrodynamics no longer appear if the theory is expanded so as to include the μ meson, a triplet of heavy axial–vector bosons, and two heavy polar–vector bosons, in addition to the electron and photon, and suitably chosen couplings between them are introduced. (auth)

10195 DIMENSIONAL REGULARIZATION AND THE ANALYTIC CONTINUATION OF β(g) IN SPACE–TIME DIMENSIONS. Bandelloni, G. (Univ., Genoa). Lett. Nuovo Cim.; 11: No. 12, 553-556(23 Nov 1974).

A study is made in a particular regularization scheme and with a fixed order of the perturbation expansion of what are the difficulties of an analytic continuation of the Symanzik function in the space–time dimension variable, even for a finite amount. Quantum electrodynamics is considered. (JFP)

10196 SUPERFIELDS. Kalnay, J. (Instituto Venezolano de Investigaciones Cientificas, Caracas, Venezuela). Lett. Nuovo Cim.; 11: No. 13, 577-580(30 Nov 1974).

A problem is solved, and a remark is stated on superspace. The problem is the following: Can the θ_α be represented by operators acting on a Hilbert space? It is recalled that superfields are fields $\phi(x,\theta)$ defined over a superspace. The answer to the question is shown to be negative. This adds further support to the concept of superspace as an essential one for superfield theory. (JFP)

10197 THE RENORMALIZATION GROUP AND THE EPSILON EXPANSION. Wilson, K. G.; Kogut, J. (Institute for Advanced Study, Princeton, N. J. (USA)). Phys. Rep.; 12: No. 2, 75-200 (Aug 1974).

251 refs.

The modern formulation of the renormalization group is explained for both critical phenomena in classical statistical mechanics and quantum field theory. The expansion in $\epsilon = 4 - d$ is explained [d is the dimension of space (statistical mechanics) or space-time (quantum field theory)]. The emphasis is on principles, not particular applications. A self-contained introduction at a fairly elementary level to the statistical mechanical theory is provided. No background is required except for some prior experience with diagrams. In particular, a diagrammatic approximation to an exact renormalization group equation is presented. The approximate renormalization group recursion formula and the Feynman graph method for calculating exponents are included. A calculation of anomalous dimensions is presented. The equivalence of quantum field theory and classical statistical mechanics near the critical point is established. Specific field theoretic references assume some background in quantum field theory. (auth)

10198 ELECTRON POSITRON ANNIHILATION INTO HADRONS AND QUANTUM ELECTRODYNAMICS AT HIGH ENERGY. Cabibbo, N.; Karl, G. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 52: No. 1, 91-94(16 Sep 1974).

A linearly raising R (s) forces QED into a Lee-Wick type of field theory. Experimental implications of this possibility and hadron models where such a linear behavior can be realized are discussed. (auth)

10199 GAUGE DEPENDENCE OF THE RENORMALIZATION GROUP PARAMETERS IN PURE YANG-MILLS THEORY. Karowski, M.; Meyer, S. (Freie Univ. Berlin (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 52: No. 1, 79-80 (16 Sep 1974).

The β-function of a massless Yang-Mills theory is gauge independent in lowest order for a general class of gauges. For a subclass of gauges including the Landau and the Coulomb gauges the effective gauge approaches the Coulomb gauge in the ultraviolet limit. (auth)

10200 LIGHT CONE AND SHORT DISTANCES. Frishman, Y. (Stanford Linear Accelerator Center, Calif. (USA)). Phys. Rep.; 13: No. 1, 1-52(Sep 1974).

152 refs.

Short distance and almost light-like distance behavior of operator products are discussed. In particular, products of electromagnetic and weak currents are treated, and applications are made to the region of deep inelastic lepton–hadron scattering. These are motivated by the observed scaling behavior in the deep inelastic region. The kinematics and light cone dominance are briefly reviewed, and then the structure of operator products at nearly light-like distances is discussed. Light cone expansions are postulated and bilocal operators are introduced. These are a generalization of Wilson's short distance expansion, and were abstracted from studies in model field theories. Applications include, among others, treatment of Regge behavior in relation to sum rules and fixed poles implied by scaling. Regarding models, the Thirring model and its generalization to include U(n) symmetry are discussed. The latter shows scale invariance for one value of the coupling constant. In both cases anomalous dimensions occur. Regarding field theories in four dimensions, gauge theories are "nearest" to canonical scaling, for which only logarithmic violations occur. The quark algebra on the light cone is reviewed, and applications to structure functions and sum rules are discussed. In e^+e^- annihilation into hadrons the various quark schemes are reviewed. In single-particle inclusive annihilation the singularity structure and multiplicity are analyzed. Finally, comments are made on various other problems and approaches. (auth)

10201 HIGHER ORDER EPSILON-TERMS IN THE RENORMALIZATION GROUP APPROACH TO REGGEON FIELD THEORY. Bronzan, J. B. (National Accelerator Lab., Batavia, Ill. (USA)); Dash, J. W. (Argonne National Lab., Ill. (USA)). Phys. Lett., B; 51: No. 5, 496-498(2 Sep 1974).

The $O(\epsilon^2)$ terms are calculated in a Wilson ϵ expansion of the scaling exponents in Reggeon field theory. These corrections are found to be comparable to the $O(\epsilon)$ terms. (auth)

10202 INVERSION TRANSFORMATION IN QUANTUM FIELD THEORY AND RECIPROCITY CONSTRAINTS. Etim, E. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Phys. Lett., B; 51: No. 5, 487-490 (2 Sep 1974).

The transformation by reciprocal radii, as an isomorphism between the two collinear SU(1,1) subgroups of the conformal group in the scaling limit, is shown to induce the reciprocity between scattering and annihilation structure functions. (auth)

10203 SPONTANEOUSLY BROKEN SUPERGAUGE SYMMETRIES AND GOLDSTONE SPINORS. Fayet, P.; Iliopoulos, J. (Ecole Normale Superieure, 75–Paris (France). Lab. de Physique). Phys. Lett., B; 51: No. 5, 461-464(2 Sep 1974).

A model is presented with a spontaneously broken supergauge symmetry which results in the appearance of a massless Goldstone spinor. The model combines supergauge invariance with ordinary gauge invariance. After the breaking the gauge boson acquires a mass as a result of the Higgs mechanism. (auth)

10204 S-MATRIX FOR FINITE QUANTUM FIELD THEORY IN THE INTERACTION REPRESENTATION. Chiang, C. C. (Texas Univ., Austin (USA). Center for Particle Theory). Nucl. Phys., B; 79: No. 1, 109-125(11 Sep 1974).

Following the theory of shadow states, a unitary S-matrix is constructed in the interaction representation for finite quantum field theory with indefinite metric. The unitarity of the S-matrix is proved. Furthermore, it is shown that the S-matrix in the interaction representation is equivalent to, at least up to a second order perturbation expansion, the S-matrix in the Heisenberg representation formulated by Gleeson and the author. (auth)

10205 SCHWINGER AND SEAGULL TERMS IN SPINOR ELECTRODYNAMICS AND THE DIMENSIONAL REGULARIZATION METHOD. De Vega, H. J.; Girotti, H. O. (La Plata Univ. Nacional (Argentina). Facultad de Ciencias Exactas). Nucl. Phys., B; 79: No. 1, 77-91(11 Sep 1974).

It is found that the extension of a local theory of fields, specifically quantum electrodynamics, to a space of continuous dimensionality together with a systematic interpretation of the relativistically invariant functions as distributions, gives rise to a rather formal but operative machinery which naturally leads to the existence of nonvanishing c-number Schwinger and seagull terms. In fact, with this kind of tool at hand, no ad hoc definitions are required to deal with products of field operators taken at the same space-time point. A complete analysis is presented of the behavior of Schwinger and seagull terms as analytic functions of the number of dimensions of the space (v). It is also shown that the Feynman conjecture (cancellation of Schwinger terms with divergencies of seagulls) holds for arbitrary v. (auth)

10206 EQUIVALENCE OF TWO DERIVATIONS OF SCALING LAWS IN ϕ^4 THEORY. Schonfeld, J.F. (Joseph Henry Laboratories, Princeton University, Princeton,,New Jersey 08540). Phys. Rev. D 10: No. 2, 755-758 (15 July 1974).

A derivation by Mueller of the Callan–Symanzik equations satisfied by moments of the deep–inelastic structure function in ϕ^4 theory is shown to be equivalent to the usual operator–product–expansion derivation. (auth)

10207 S MATRIX FOR FINITE QUANTUM ELECTRODYNAMICS IN THE HEISENBERG REPRESENTATION. Chiang, C.C.; Gleeson, A.M. (Center for Particle Theory, University of Texas at Austin, Austin, Texas 78712). Phys. Rev. D 10: No. 2, 573-588 (15 July 1974).

In this paper we present a covariant formulation of the S matrix in the Heisenberg representation for finite quantum electrodynamics. The theory involves the use of an indefinite metric implemented with the idea of shadow states. The indefinite metric is used to make the theory finite, and the idea of shadow states is introduced to make the S matrix for physical scattering processes unitary. The equations of motion for the field operators are solved with the boundary conditions fixed in accordance with the idea of shadow states. The consequences of this choice of boundary conditions is exhibited in the problem of vacuum polarization. It turns out that the analytic properties of the S matrix element in this formalism are quite different from those in conventional theory. Following the methods of Källén and of Yang and Feldman, we proceed to construct the S matrix for physical scattering processes. The explicit forms for the S matrix in the perturbation expansion up to second order in e are given. Some unfamiliar features of this formalism, such as (1) the presence of noncausal effects, (2) piecewise analyticity of the scattering amplitudes, and (3) the reinterpretation of crossing symmetry are also discussed. (auth)

10208 $\phi_2{}^4$ QUANTUM FIELD MODEL IN THE SINGLE–PHASE REGION: DIFFERENTIABILITY OF THE MASS AND BOUNDS ON CRITICAL EXPONENTS. Glimm, J.; Jaffe, A. (Institut des Hautes Etudes Scientifiques, Bures–sur–Yvette, Essonne, France). Phys. Rev. D 10: No. 2, 536-539 (15 July 1974).

We prove that the physical mass m is a differentiable function of the bare mass m_0 down to the critical point (defined by the occurrence of $m = 0$ or of the onset of symmetry breaking). We derive an upper bound on $m(m_0)$. We show that the critical exponents, η,ν,γ,ξ are bounded from below by their classical values. (auth)

10209 SINGLE–SPECTRAL FORMS FOR THREE–POINT FUNCTIONS: THE GENERAL–MASS SITUATION. Ivanetich, R.J. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 10: No. 2, 468-479 (15 July 1974).

The establishment of spectral forms in source theory has been systematically studied, with it being a natural consequence of the causal methods employed therein that these results apply only for limited ranges of the particle masses. Here the three–point–function single–spectral form, considered in lowest nontrivial order and for scalar particles, is extrapolated to completely general values of the masses. The arguments employed continue in the physically oriented vein of source theory, not being founded on analyticity, and some consistency checks on these methods are included. In the case of stable particles the common spectral form with anomalous threshold is obtained, while for unstable particles the spectral mass squared can assume negative or complex values and the spectral weight function can take on an imaginary part. All the results are summarized in tabular form. (auth)

10210 CONFORMAL TRANSFORMATIONS FOR QUANTIZED FIELDS. Schroer, B. (Institut für Theoretische Physik, Freie Universität, Berlin, Germany); Swieca, J.A. Phys. Rev. D 10: No. 2, 480-485 (15 July 1974).

Finite conformal transformations for quantized fields are obtained. The apparent conflict with Einstein's causality principle is resolved. It is shown that in quantum field theory one is in general dealing with representations of the universal covering group of the conformal group. (auth)

10211 MASS SINGULARITIES IN AN APPROXIMATION TO SINGLE–FERMION–LOOP VACUUM POLARIZATION. Shalloway, D. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 10: No. 2, 486-492 (15 July 1974).

The approximation to $f_1(\alpha)$ recently suggested by Johnson and Baker is considered in low–order perturbation theory. Divergences occurring when massless electrons and positrons become parallel are discussed and are shown to make the approximation unusable. (auth)

10212 PHOTON PAIR CREATION IN INTENSE MAGNETIC FIELDS. Tsai, W. (Department of Physics, University of California, Los Angeles, California 90024); Erber, T. Phys. Rev. D 10: No. 2, 492-499 (15 July 1974).

The vacuum polarization of photons in intense, homogeneous magnetic fields is recalculated, using a proper–time method presented by Schwinger. This result is applied to compute exactly, in closed form, the photon absorption coefficient due to pair creation, $\kappa_{\parallel,\perp}$, corresponding to the polarization of the photon parallel or perpendicular to the plane of the photon momentum $\vec{k}$ and the homogeneous magnetic field $\vec{H}$. Specializing this general expression to the high–frequency, weak–field limit yields

$$\kappa_{\parallel,\perp}(\omega) = \tfrac{1}{2}\,\alpha\sin\theta\,\omega_H\,\frac{4\sqrt{3}}{\lambda\pi}\int_0^1 \frac{d\nu}{1-\nu^2}\,[(1-\frac{1}{3}\nu^2)_\parallel,\ (\frac{1}{2}+\frac{1}{6}\nu^2)_\perp]\,K_{2/3}\left(\frac{4}{\lambda(1-\nu^2)}\right)\quad,$$

where $|\vec{k}| = \omega$, $\lambda = 3/2(eH/m^2)\,(\omega/m)\sin\theta$, $\omega_H = eH/m$, and θ is the angle between $\vec{k}$ and $\vec{H}$. Comparing this expression with those obtained in the prior computations, we find that ours is more compact and much simpler in form and that ours is a simplified version of theirs. (auth)

10213 DOUBLE SPECTRAL REPRESENTATIONS OF SINGLE LOOP AMPLITUDES WITH k VERTICES: $k \geq 4$. Frederiksen, J.S. (Institute for Theoretical Physics, University of Groningen, The Netherlands). J. Math. Phys. (N.Y.) 15: No. 11, 1826-1834 (Nov 1974).

A method developed in several previous papers is combined with the method of induction to derive double dispersion relations, with Mandelstam boundary, for the class of single loop amplitudes with four or more vertices. The spectral functions are expressed as integral representations and restrictions on the masses and kinematic invariants for which dispersion relations are valid are found. It is also discussed how representations for the low order single loop amplitudes can be obtained for wider ranges of these variables. (auth)

10214 ZEROS AND INFINITIES OF THE CALLAN–SYMANZIK FUNCTION β IN A PERTURBATIVE APPROACH TO THE DASHEN-FRISHMAN MODEL. Roemer, H.; Yangielowicz, S. (Weizmann Inst. of Science, Rehovoth (Israel)); Rubinstein, H. R. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 79: No. 2, 285-300(18 Sep 1974).

The Dashen-Frishman U(n)-symmetric generalized Thirring model is investigated in terms of perturbation theory. The possibility of an ϵ-expansion is established. The coefficient function $\beta(g)$ must have a singularity, which might also appear in more realistic models and possibly has important consequences for the ir and uv limits of field theories. (auth)

10215 A NOTE ON THE MINIMALLY COUPLED BHABHA FIELD. Nagpal, A. K. (Delhi Univ. (India). Dept. of Physics and Astrophysics). Nucl. Phys., B; 80: No. 2, 206-220(11 Oct 1974).

The Bhabha field with multimass and maximum spin S, a system transforming reducibly under a representation of the homogeneous Lorentz group, is considered. The field is quantized in the presence of a minimally coupled electromagnetic field. The relation $\Psi(\chi) = \Psi(\chi/\sigma)$ does not hold for the case of S integer (contrary to the half-integer S or lower spin ($S < 1$) case), but the usual difficulties of high-spin field theories seem to be absent. The propagation of the interacting (classical) equations is casual, since their principal part is unaffected by the introduction of an interaction, analogous to the lower spin case. This good nature of the Bhabha field equations appears due to the absence of secondary constraints. This is further supported with a similar example of a vector–spinor field. (auth)

10216 STRUCTURE OF COUNTERTERMS IN DIMENSIONAL REGULARIZATION. Collins, J. C. (Cambridge Univ. (UK)). Nucl. Phys., B; 80: No. 2, 341-348(11 Oct 1974).

With the aid of dimensional regularization a simple proof is given that every renormalizable field theory has a renormalization prescription with the following properties: (a) The counterterms are polynomials in the massive renormalized parameters (the masses, in particular). (b) These polynomials only have terms in which the massive parameters occur as a factor with the same dimension as the counterterm. To see what these properties mean in a theory with several massive parameters, the example of scalar Yukawa theory is considered, and the form of the counterterms in our special renormalization prescription is given. It is seen that this is very much simpler than what is allowed in a general prescription. (auth)

10217 CUTOFF METHOD AND ON THE MULTIPLE PRODUCTION IN HIGH ENERGY COLLISIONS. Wataghin, G. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 54: No. 3, 451-456(Mar 1973).

Some aspects are pointed out in an attempt to eliminate the ultraviolet divergences in a quantized field theory proposed earlier called the cut-off method. The energy losses in successive collisions of a high energy cosmic ray proton which are accompanied by a multiple production are considered. (JFP)

10218 DYNAMICS OF RELATIVISTIC VORTEX LINES AND THEIR RELATION TO DUAL THEORY. Foerster, D. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., B; 81: No. 1, 84-92(25 Oct 1974).

The dynamics of relativistic vortex lines that occur in some classical field theories are analyzed. It is proved that in the zero-width limit they move like Nambu strings. The relevance of vortex lines to the corresponding quantum field theory is also discussed. (auth)

10219 SPONTANEOUS PROCESSING IN VACUUM. Zeldovich, Ya. B. (Institute of Applied Mathematics, Moscow (USSR)). Phys. Lett., B; 52: No. 3, 341-343(14 Oct 1974).

The theory of spontaneous vacuum explosion gives divergent probability due to Lorentz invariance of the initial state. Evidently such an explosion is strictly forbidden by conservation laws, which implies nonexistence of tachyons. (auth)

10220 THE ABELIAN HIGGS KIBBLE MODEL, UNITARITY OF THE S-OPERATOR. Becchi, C.; Rouet, A.; Stora, R. (Centre National de la Recherche Scientifique, 13 – Marseille (France).

Centre de Physique Theorique). Phys. Lett., B; 52: No. 3, 344-346(14 Oct 1974).

Results concerning the renormalization of the abelian Higgs Kibble model in the 't Hooft gauges are presented. A direct combinatorial proof of the unitarity of the physical S-operator is described. (auth)

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Refer also to abstracts 9533 and 9534.

10221 QUANTUM GRAVITY AS A GAUGE FIELD THEORY. 't Hooft, G. (CERN, Geneva). pp 263-274 of Renormalization and Invariance in Quantum Field Theory. Caianiello, E. R. (ed.). New York; Plenum Publishing Corp. (1974).

From proceedings on renormalization and invariance in quantum field theory; Capri, Italy (1 Jul 1973). See CONF-730745-.

The resolution of the problem of which of the fields $g_{\mu\nu}$, $g^{\mu\nu}$, $\sqrt{g}\, g^{\mu\nu}$, or perhaps the a_μ^a (Vierbein field) is to be chosen as the elementary field is considered. Also an important remark concerning counter terms for the theory of pure gravity is made. (JFP)

10222 ELECTRON, MUON, PROTON, AND STRONG GRAVITY. Tennakone, K. (Department of Physics, Vidyodaya Campus, University of Sri Lanka, Nugegoda, Ceylon). Phys. Rev. D 10: No. 6, 1722-1725 (15 Sept 1974).

Regarding the strong interaction as a manifestation of a strong gravity, the electron and the proton are identified as black holes in the strong gravitational field. The mass and classical radius of the electron are predicted to be $1/2\alpha m_\pi = 0.51$ MeV and $r_e = e^2/2m_p c^2 = 0.74 \times 10^{-16}$ cm, respectively. It is shown that the electron can be strongly interacting at energies above 240 GeV. The strong gravitational constant is predicted to 3.9×10^{31} dyn cm^{2}g^{-2}. The neutron–proton mass difference is partly explained. A neutral–pion–electron system bound by strong gravity is interpreted as the muon, and the muon–electron mass ratio is predicted to be $m_\mu/m_e = (3/2)(1/\alpha) + (2/\alpha)m_e/m_\pi = 206.6$. It is suggested that the weak interaction might also be a manifestation of strong gravity and the intermediate–boson mass is of order 240 GeV. (auth)

10223 TEUKOLSKY EQUATION AND PENROSE WAVE EQUATION. Ryan, M.P., Jr. (Center for Relativity Theory, University of Texas at Austin, Austin, Texas, 78712). Phys. Rev. D 10: No. 6, 1736-1740 (15 Sept 1974).

It is shown that Teukolsky's equation can be derived from a second–order wave equation for the Riemann tensor. The derivation is done in a way that emphasizes the modern tensor–analysis content of the Newman–Penrose formalism. (auth)

10224 PRODUCING AN ULTRAHIGH–UNIFORMITY GRAVITATIONAL FIELD. Long, D.R.; Ogden, D. (Eastern Washington State College, Cheney, Washington 99004). Phys. Rev. D 10: No. 6, 1677-1680 (15 Sept 1974).

We present a new "double–ring" source mass distribution which produces a gravitational field which varies by less than one part in one hundred billion for a 0.025% change in the position of the test point. Such a source mass distribution removes a major obstacle to making ultrahigh–precision measurements of the gravitational field in the laboratory: the formidable problem of precisely locating the test mass. The double–ring source mass would allow the gravitational inverse square law to be tested in the laboratory using current position–measuring techniques to an accuracy one thousand times better than the limits now given by perihelion data. (auth)

10225 GRAVITATIONAL WAVES: THE NONLINEARIZED THEORY. Barnebey, T.A. (Department of Physics and Astronomy, California State College, Sonoma, Rohnert Park, California 94928). Phys. Rev. D 10: No. 6, 1741-1748 (15 Sept 1974).

A simple reformulation of general relativity is developed by dividing the geometry of space–time into a background part and a gravitational–wave part and foregoing any weak-field approximations. A study of the resulting formalism uncovers three main features: (1) Einstein's field equation can be derived from a Lagrangian which is a scalar density, but which depends only upon certain Lagrange coordinates and their first derivatives, (2) two new divergence relations arise from the coordinate invariance of the wave–background action, and (3) a symmetric energy–momentum tensor can be naturally associated with the waves. Various aspects of the nonlinearized theory are compared with their counterparts in earlier studies of relativity and gravitational waves. (auth)

10226 COMMENT ON THE SCHIFF CONJECTURE. Ohanian, H.C. (Rensselaer Polytechnic Institute, Troy, New York 12181). Phys. Rev. D 10: No. 6, 2041-2042 (15 Sept 1974).

We present a counterexample to the conjecture that the weak equivalence principle implies the Einstein equivalence principle. (auth)

10227 CONSERVATION LAWS AND VARIATIONAL PRINCIPLES IN METRIC THEORIES OF GRAVITY. Lee, D.L.; Lightman, A.P. (California Institute of Technology, Pasadena, California 91109); Ni, W. Phys. Rev. D 10: No. 6, 1685-1700 (15 Sept 1974).

Conservation of energy, momentum, and angular momentum in metric theories of gravity is studied extensively both in Lagrangian formulations (using generalized Bianchi identities) and in the post–Newtonian limit of general metric theories. Our most important results are the following: (i) The matter response equations $T^{\mu\nu}{}_{;\nu} = 0$ of any Lagrangian–based, generally covariant metric theory (LBGCM theory) are a consequence of the gravitational–field equations if and only if the theory contains no absolute variables. (ii) Almost all LBGCM theories possess conservation laws of the form $\Theta_\mu{}^\nu{}_{,\nu} = 0$ (where $\Theta_\mu{}^\nu$ reduces to $T_\mu{}^\nu$ in the absence of gravity). (iii) $\Theta_\mu{}^\nu$ is always expressible in terms of a superpotential, $\Theta_\mu{}^\nu = \Lambda_\mu{}^{[\nu\alpha]}{}_{,\alpha}$. If the superpotential $\Lambda_\mu{}^{[\nu\alpha]}$ can be expressed in terms of asymptotic values of field quantities, then the conserved integral $P_\mu = \int Q_\mu{}^\nu d^3\Sigma_\nu$ can be measured by experiments confined to the asymptotically flat region outside the source. (iv) In the Will–Nordtvedt ten–parameter post–Newtonian (PPN) formalism there exists a conserved P_μ if and only if the parameters obey five specific constraints; two additional constraints are needed for the existence of a conserved angular momentum $J_{\mu\nu}$. (This modifies and extends a previous result due to Will.) (v) We conjecture that for metric theories of gravity, the conservation of energy–momentum is equivalent to the existence of a Lagrangian formulation; and using the PPN formalism, we prove the post–Newtonian limit of this conjecture. (vi) We present "stress–energy–momentum complexes" $\Theta_\mu{}^\nu$ for all currently viable metric theories known to us. (auth)

10228 TYPE-(3,1) SOLUTION TO THE VACUUM EINSTEIN EQUATIONS. Held, A. (Univ., Bern). Lett. Nuovo Cim.; 11: No. 12, 545-546(23 Nov 1974).

It was previously indicated that as yet no example of a type-(3,1) vacuum metric with a twisting-degenerate-principle null vector was known. The metric displayed is an example. (JFP)

10229 ONE–LOOP DIVERGENCES OF QUANTIZED EINSTEIN–MAXWELL FIELDS. Deser, S.; van Nieuwenhuizen, P. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 10: No. 2, 401-410 (15 July 1974).

The one–loop divergences of the quantized Einstein–Maxwell system are calculated, using dimensional regularization and the background–field method. The resulting counterterms, including photon and graviton ghost contributions are quadratic in curvatures when evaluated on the mass shell, and cannot be renormalized away by rescaling. Brans–Dicke theory is also nonrenormalizable; source–free Einstein theory with cosmological term is (formally) renormalizable, as are Weyl models. (auth)

10230 NONRENORMALIZABILITY OF THE QUANTIZED DIRAC–EINSTEIN SYSTEM. Deser, S.; van Nieuwenhuizen, P. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 10: No. 2, 411-420 (15 July 1974).

The coupled Dirac–Einstein system is quantized and shown to be one–loop nonrenormalizable: The diagrams with eight external fermions yield a divergence proportional to the fourth power of the fermion axial–vector current. The gravitational variables required to couple gravitation to fermions are the (sixteen) vierbein fields possessing local Lorentz as well as coordinate invariance. For gravitation coupled to bosons, the vierbein and metric formulations remain equivalent at the quantum level. (auth)

10231 SCALAR– AND MATTER–DOMINATED COSMOLOGIES IN SCHWINGER'S SCALAR–TENSOR THEORY OF GRAVITY. Milton, K.A. (Department of Physics, University of California, Los Angeles, California 90024); Ng, Y.J. Phys. Rev. D 10: No. 2, 420-428 (15 July 1974).

A scalar–tensor theory of gravity, suggested by Schwinger, is reviewed. This theory is like the Brans–Dicke one in that the gravitational constant is time–dependent, and in fact coincides with it whenever the scalar field is weak. It is argued that the apparent discrepancy between the observed mass density of galaxies and the density required by standard cosmologies with $q_0 \sim 1$ may be resolved by supposing that we are still in an era in which the scalar field is the dominant source of gravity. Solutions in such an era are discussed, and it is seen that they can be characterized by an increasing gravitational constant. Finally, the more conventional matter–dominated regime is treated. (auth)

10232 INITIAL–VALUE PROBLEM OF GENERAL RELATIVITY. I. GENERAL FORMULATION AND PHYSICAL INTERPRETATION. Ó Murchadha, N.; York, J.W. Jr. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540 and Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). Phys. Rev. D 10: No. 2, 428-436 (15 July 1974).

The initial–value equations of Einstein's theory of general relativity are formulated as a system of four coupled quasilinear elliptic equations.

These equations result from a covariant orthogonal decomposition of symmetric tensors and a generalized technique of conformal deformation of initial data. Mathematical properties and global integrability conditions of the equations are discussed. Physical interpretation of the independent and dependent data is given for both spatially closed and asymptotically flat initial–data sets. In the latter case, the four dependent functions constitute long–range scalar and vector potentials which determine the total mass and total linear and angular momenta of an isolated system. The definitions of linear and angular momenta suggest a unique extension to asymptotically flat three–spaces of the group of translations and rotations of flat three–space. In turn, the "almost symmetries" thus defined lead to Gaussian theorems expressing the equality of certain surface and volume integrals for total linear and angular momenta. An interpretation of the scalar and vector potentials for closed three–spaces is also given. In the Appendix we treat the special case of conformally flat initial data. (auth)

10233 INITIAL–VALUE PROBLEM OF GENERAL RELATIVITY. II. STABILITY OF SOLUTIONS OF THE INITIAL–VALUE EQUATIONS. Ó Murchadha, N.; York, J.W. Jr. (Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). Phys. Rev. D 10: No. 2, 437-446 (15 July 1974).

We discuss the completeness and "linearization stability" of the initial–value constraints. We show that all closed solutions for which the intrinsic geometry possesses a conformal symmetry are incomplete, but stable. All closed, vacuum, moment–of–time symmetry solutions are incomplete, but only the flat case is unstable. This particular incompleteness vanishes on the addition of any source field. All other closed solutions to the initial–value constraints for which the trace of the momentum is a covariant constant are complete and stable except those solutions where the metric and the momentum have the same exact symmetry. All such closed, vacuum solutions are unstable. All asymptotically flat maximal solutions are complete and stable. In this paper we treat only the linearization stability of the initial–value constraints and make no statements about the dynamical stability of the solutions. (auth)

10234 WEYL TENSOR DECOMPOSITION IN STATIONARY VACUUM SPACE–TIMES. Glass, E.N. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). J. Math. Phys. (N.Y.) 15: No. 11, 1930-1931 (Nov 1974).

The electric and magnetic parts of the Weyl tensor are represented as symmetrized derivatives of gradient vector fields in stationary vacuum space–times. It is shown that a necessary and sufficient condition for a stationary, vacuum space–time to be static is that the Weyl tensor be electric type. It is further shown that the only stationary vacuum space–time with vanishing electric type Weyl tensor is flat space. (auth)

10235 THE ANALYTIC NONCHARACTERISTIC CAUCHY PROBLEM FOR NONLIGHTLIKE ISOMETRIES IN VACUUM SPACE–TIMES. Berezdivin, R. (Departamento de Física, Facultad de Ciencias, Universidad Central de Venezuela, Caracas, Venezuela). J. Math. Phys. (N.Y.) 15: No. 11, 1963-1966 (Nov 1974).

The analytic noncharacteristic problem for the existence of a spacelike isometry in vacuum space–time, given its existence on the hypersurfaces, on the Cauchy data, is posed and solved using the ADM equations. The timelike case is also solved. In both cases the isometry will locally exist. (auth)

10236 INTERACTION AND TRANSFORMATION OF ELECTROMAGNETIC AND GRAVITATIONAL WAVES IN EINSTEIN–MAXWELL FIELD. Tokuoka, T. (Department of Aeronautical Engineering, Kyoto University, Kyoto, Japan). J. Math. Phys. (N.Y.) 15: No. 11, 1972-1976 (Nov 1974).

The interaction and the transformation of the electromagnetic and gravitational waves and the variation of those amplitudes are analyzed theoretically, where the Einstein–Maxwell field is assumed. Two waves are defined such that the electromagnetic vector potentials and the gravitational tensor potentials and their first derivatives are continuous while their second derivatives are discontinuous at a wave front. It is proved that the concomitant electromagnetic and gravitational waves can interact with each other if an external electromagnetic field exists. The global behaviors of interaction and transformation of the two concomitant waves are also investigated, where a Lorentz metric space–time is assumed. The variation formulas for amplitude are derived. The amplitudes may grow or decay according to a factor depending on the mean and Gaussian curvatures of an initial wave front and to a factor depending on the external electromagnetic field. When there is no external electromagnetic field, there is no interaction between the two waves and they propagate independently, while when an external field exists, the electromagnetic wave may transform into the gravitational wave and vice versa. In a case of a weak constant external electromagnetic field, where a flat space may be assumed, the amplitude of a wave varies sinusoidally with respect to the distance measured along its ray. The length of interchangeability is defined by the length in which a wave is completely transformed into its dual wave, and it is inversely proportional to the strength of an external electromagnetic field. (auth)

10237 ELECTRIC AND MAGNETIC CHARGE IN EINSTEIN'S UNIFIED FIELD THEORY. Gaffney, G.W. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 2, 374-400 (15 July 1974).

Some new approximate solutions to the field equations of Einstein's unified field theory are constructed, and the physical significance of the theory is examined. According to the conventional physical interpretation of the theory, the singularities of the new solutions should represent magnetically charged point masses. It is found that in order to satisfy the field equations, such solutions must contain not only the usual pointlike singularities, but also "string" singularities similar to those in Dirac's theory of magnetic poles. It is possible, nevertheless, to derive equations of motion for the pointlike charges at the ends of the "strings," which turn out to be very similar to the Lorentz–Dirac equation. The paths of the "strings" are not arbitrary, but must also satisfy certain constraint conditions. On the basis of the equations of motion obtained, it is suggested that it may be possible to make an alternative physical interpretation of Einstein's theory, in which the point singularities of the new solutions are electric charges, rather than magnetic charges. The conventional interpretation of the theory is based on equations of motion found by Johnson, for some different approximate solutions to the field equations. If either interpretation is accepted, then the equations of motion in each case imply modifications of Maxwell's equations for macroscopic electromagnetic fields. The modifications are similar, but not identical, in the two cases. Some observational tests of the modified electro–magnetic fields predicted by the theory are discussed, with emphasis on contrasting the two possible interpretations of electric charge. In each case, the field which deviates from the usual Maxwell theory involves a length parameter, an integration constant whose magnitude is not fixed by the theory, at this stage. It is shown that terrestrial tests of Maxwell's equations imply that this length must be greater than about 15 Earth radii, regardless of which interpretation one supposes to be true. It is then observed that the theory does imply an upper bound on the length parameter. Although this theoretical upper limit is not precise, a limit only a few orders of magnitude larger than the current experimental lower limit is suggested. This means that Einstein's theory deviates significantly from Maxwell's theory over astronomical distances. Some astrophysical situations where effects of the theory could be seen in static magnetic dipole fields are mentioned. These offer the possibility of testing whether Einstein's theory is correct, and of determining which type of singularity represents a point electric charge. (auth)

10238 PHOTON CORRECTIONS TO THE GRAVITON PROPAGATOR. Capper, D.M.; Duff, M.J.; Halpern, L. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 10: No. 2, 461-467 (15 July 1974).

The one–loop photon contribution to the graviton self–energy is calculated using the technique of dimensional regularization and the resulting amplitude is found to satisfy the appropriate Slavnov–Ward identities. The infinite part can be removed by counterterms of the form $\sqrt{g}(R^2 - 3R_{\mu\nu}R^{\mu\nu})$ and the finite part is compared with the previously derived graviton–loop contribution. (auth)

10239 JEANS' CRITERION IN THE PRESENCE OF HEAT DIFFUSION AND VISCOSITY. Krueger, J. G. (Ghent Rijksuniversiteit (Belgium). Seminarie voor Wiskundige Natuurkunde). Phys. Lett., A; 49: No. 4, 347-348(23 Sep 1974).

The dispersion relation for an infinitely extended homogeneous self-gravitating medium is derived in the presence of heat conduction and viscosity, for the usual as well as for the modified Navier-Stokes equation. The influence of the damping on the onset of instability is studied. (auth)

10240 DISCUSSION ABOUT MEANING OF SINGULARITIES IN THE GENERAL THEORY OF RELATIVITY. Bucci, P. (Centro di Applicazioni Militare dell'Energia Nucleare, Pisa, Italy). Acta Phys. Austr.; 40: No. 1, 43-51(1974).

The question of the nonvalidity of field equations within the source of the field, and it is suggested that a high condensation of matter at these points is not the cause of this nonvalidity. It is shown that it is not possible to exceed a certain value of material condensation. The problem of the singularity of a single mass is then extended to the cosmological problem, where it is usually considered that all galaxies were initially in an infinitely small volume which was, therefore, occupied by an extremely condensed matter. A formula is given showing the critical ratio of mass of a body to its radius "ideally" constructed through a "theoretical process of condensation." (IAA)

10241 POST-NEWTONIAN APPROXIMATION OF THEORIES OF GRAVITY. Kasper, U.; Liebscher, D. E. (Deutsche Akademie der Wissenschaften, Babelsberg, Ger.). Astron. Nachr.; 295: No. 1, 11-17(1974).

The general framework of the post-Newtonian approximation considered by Thorne and Will (1971) is based on the fact that the motion of nongravitational matter in the gravitational field is determined by a metric via a dynamic equation. Questions concerning the completeness of the framework are discussed along with restrictions arising from the differential equations. The physical meaning of the parameters is considered. A condition for the existence of post-Newtonian conservation laws is shown to be necessary and sufficient for the existence of a variational principle for a number of derived equations which represent most of the considered theories. (IAA)

10242 DUAL MODELS AND THE GEOMETRY OF SPACE–TIME. Scherk, J.; Schwarz, J. H. (California Inst. of Tech., Pasadena (USA)). Phys. Lett., B; 52: No. 3, 347-350(14 Oct 1974).

The zero slope limit of the closed string sector of a dual model yields a Lagrangian theory in which space–time has a non-Riemannian geometry. It is found that there is torsion but no homothetic curvature. (auth)

REACTOR TECHNOLOGY AND REGULATION

10243 (NP-20237) ANNUAL REPORT, 1973. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Aug 1974. 87p. (In German). Dep. NTIS (US Sales Only) $7.50.

Information on research projects is presented concerning reactor physics and dynamics, emergency core cooling, containment problems, system analysis and reliability techniques, analysis of dynamic processes, reactor control, and use of computer systems. (DCC)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 8325, 10261, 10305, 10309, 10310, 10312, 10313, 10315, 10320, 10322, 10325, 10327, 10331, 10339, 10340, and 10403.

10244 (AD-777447) COMPARISON OF TWO REACTOR SCRAM SYSTEM ALGORITHMS DURING REACTIVITY PERTURBATIONS. Sarkisov, A. A.; Puchkov, V. N. Translated from At. Energ. (USSR); 3: No. 2, 134-135([nd]). 6p. NTIS $4.00.

Emergency conditions in a water-cooled, water-moderated reactor operating on U235-base fuel are discussed. The perturbing effects were introduced at constant rates by changing the reactivity. (auth)

10245 (NEDO-20360(Rev.1)) GENERAL ELECTRIC BOILING WATER REACTOR GENERIC RELOAD APPLICATION FOR 8 × 8 FUEL. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Nov 1974. vp.

A description of current reload 8 × 8 fuel designs and results of the evaluation of the refueled core are presented. Safety evaluations and design criteria, methods, and results common to all 8 × 8 reloads are described in sections dealing with reload fuel mechanical design, reload core thermal-hydraulics, nuclear characteristics, and bounding safety analyses. (DG)

10246 PUMPS FOR BWR NUCLEAR POWER PLANT. Onoda, T.; Suzuki, A. (Hitachi Ltd., Tokyo). Hitachi Hyoron; 56: No. 7, 627-630(Jul 1974). (In Japanese).

A large number of pumps for BWR nuclear power plant use has been designed and manufactured by Vitachi. These pumps differ from conventional ones for other type of power plants in many respects. Required characteristics of the main pumps for BWR nuclear power plants are described together with selection of pump type, pump construction and trends of pump capacity growth. (JA)

10247 JET PUMP FOR NUCLEAR REACTOR. Gluntz, D. M.; Fitzsimmons, G. W. Jr.; Wolf, S.; Kudirka, A. A. (to General Electric Co.). US Patent 3,838,002. 24 Sep 1974. Filed date 21 Jul 1972. 8p.

A description is given of a jet pump coolant circulation system for a nuclear reactor wherein the combination of multiple nozzles and a divergent mixer section provide increased efficiency in jet pumps of given length. (Official Gazette)

10248 REMOVABLE HEAD PRESSURE VESSEL, ESPECIALLY FOR BOILING-WATER REACTOR. Costes, D. (to Commissariat a l'Energie Atomique). US Patent 3,834,452. 10 Sep 1974. Priority date 21 Apr 1971, France. 6p.

A description is given of a pressure vessel having a top opening, a lid for the tight closure of the opening which is provided with a seal forming a leak-tight joint with the main portion and which is provided at the bottom portion with a heat-insulating plug extending below the level of the leak-tight joint between the lid and the main portion. The heat-insulating plug has a continuous downwardly projecting peripheral skirt and the main portion comprises a trough placed in such manner that the skirt extends therein when the lid is in position. (Official Gazette)

10249 INSERVICE INSPECTION OF NO. 2 REACTOR IN FUKUSHIMA NUCLEAR POWER PLANT. Nakamura, R. (Tokyo Electric Power Co. Inc., Japan). Karyoku Genshiryoku Hatsuden; 25: No. 3, 219-234(Mar 1974). (In Japanese).

Preservice inspection of the Fukushima-2 reactor is described. The preservice inspection employed a remotely controlled automatic ultrasonic testing system in regions of high radiation level such as the reactor core and employed a manual ultrasonic testing system or other non-destructive inspection methods in the other regions. The methods of inspection employed for the reactor were visual testing, surface testing, and volume testing as prescribed in ASME CODE. The preservice inspection was satisfactorily performed. Some problems were pointed out. In the ultrasonic inspection of welded joints, relatively high echo was generated from the back side, so that it was difficult to distinguish defect echo and back echo. Therefore, the back surface of welded parts must be finished. It was not possible to perform ultrasonic tests in welded parts of austensite stainless steel, for the decay of the ultrasonic wave was very pronounced. (JA)

10250 SURVEY OF APPLIED INSTRUMENT SYSTEMS FOR USE WITH LIGHT-WATER-REACTOR CONTAINMENTS. Tuxen-Meyer, H. Nucl. Safety; 15: No. 6, 702-710(1974).

Data related to the instrumentation, testing practices, and monitoring procedures for boiling- and pressurized-water-reactor containment atmospheres are summarized. Questionnaires were sent to a representative selection of reactor installations in the United States, West Germany, and Sweden which had either recently started operation or were still under construction. Compilation of the answers in tabular form revealed surprising differences between the different instrument arrays in regard to the design criteria employed. The survey indicates that further information regarding instrumentation philosophy is needed. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 8325, 10244, 10247, 10250, 10305, 10306, 10308, 10309, 10312, 10313, 10315, 10321, 10325–10327, 10331, 10335, 10339, 10340, 10391, and 10393.

10251 (BAW-3647-29) PHYSICS VERIFICATION PROGRAM PART III, TASKS 9 AND 10. Quarterly Technical Report, October–December 1973. Baldwin, M. N.; Warren, H. D.; Webb, H. W. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Research and Development Div.). Jul 1974). Contract AT(11-1)-3109. 53p. Dep. NTIS $5.75.

Experimental Task 9 was conducted to compare the fission rate within the fuel rods of a critical assembly with the neutron absorption rate in adjacent pins containing simulated lumped burnable poison (LBP) material. The experimental assembly, a water-moderated, slightly enriched UO_2 lattice perturbed by the simulated LBP and dissolved boric acid, is arranged to mock up the fuel elements of a commercial pressurized water reactor (PWR). These results will serve to check analytical techniques used in the design of large PWRs. Experimental Task 10 was conducted to obtain data for use in assessing the relative magnitude of the neutron and gamma induced signal components from an all-solid, prompt-responding incore detector. The measurements were conducted in three separate, slightly enriched UO_2 lattices which are designed to provide a wide range for the neutron-to-gamma ratio and for the neutron spectrum. (auth)

10252 (BAW-3647-30) PHYSICS VERIFICATION PROGRAM PART III, TASK 11. Quarterly Technical Report, January–March 1974. Baldwin, M. N. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Research and Development Div.). Jul 1974. Contract AT(11-1)-3109. 19p. Dep. NTIS $4.00.

The reactivity and power perturbation effects of poison pins in mockups of 17 by 17 fuel assemblies were measured. The experimental facility—a water-moderated, slightly enriched UO_2 lattice—is arranged to mock up the fuel assemblies of a commercial pressurized water reactor. Each assembly contains 24 poison pin positions. (auth)

10253 (CEA-CONF-2672) IN-SERVICE INSPECTION: STATUS OF STUDIES AT THE C. E. A. Saglio, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). 1974. 30p. (In French). (CONF-740676-2). Dep. NTIS (US Sales Only) $4.50.

From conference on in-service inspection of pressure vessels; London, UK (4 Jun 1974).

A machine developed for the remote inspection of the primary circuit of a PWR is described in detail. The techniques used for the acquisition and interpretation of data are given. (JSR)

10254 RAPID REFUELING SYSTEM FOR NUCLEAR POWER PLANTS. Andrews, N. H.; Deroy, G. L.; Olmstead, C. A.

(Westinghouse Electric Corp., Monroeville, PA). Energ. Nucl. (Milan); 21: No. 11, 617-624(Nov 1974).

A description is given of the Westinghouse Rapid Refueling System, an integrated package of equipment designs that can reduce the refueling time to less then seven days and thereby permit improvements in plant operating flexibility and nuclear fuel economics, and a reduction in manpower requirements. (auth)

10255 CONTROL OF A NUCLEAR POWER PLANT BEFORE REACTOR OPERATION. Potemans, M. (Kerncentrale, Deol, Belg.); Gilly, L. Electricite; No. 159, 29-38(1974). (In French).

The safety, reliability, and profitability of nuclear power plants receive particular attention because of the harmful effects of a potential accident, their high unit power, and their use as base units for the production of electricity. That is why the quality controls during fabrication and the preoperational tests and the tests at start-up should be and are much more rigid than for conventional power plants. An attempt is made to describe briefly these controls and tests which are applied to nuclear power plants of the pressurized water type such as those at Doel and Tihange. Quality control during fabrication, preoperational tests, and the commissioning of the power plant are discussed. Although the majority of the components and systems of a nuclear power plant do not differ in principle from those of a conventional power plant, some of them are specific to nuclear power plants. These are, primarily, the sealed pressure vessel, the control rods, the reactor vessel, and the processing of radioactive wastes. Only those aspects peculiar to nuclear power plants which are subjected to particular tests and to more severe controls than their conventional outerparts are considered. (tr-auth)

10256 MEASURING AND ANALYSIS METHODS APPLIED TO ON-LINE VIBRATION AND NOISE MONITORING IN PWR POWER PLANTS. Bastl, W. (Laboratorium fuer Reaktorregelung und Anlagensicherung Garching, D-8046 Garching, Reaktorstation, Germany). Nucl. Eng. Des.; 28: No. 3, 377-386(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Measurements and analyses performed in a PWR plant are discussed in the light of their relevance for application to an on-line monitoring system. This is achieved by extensive investigations during the preoperational tests. The results gained are transferred to the situation existing during full power operation by means of spectral analysis and correlation techniques. Theoretical models provide further proof of the results. The final conclusions show the consequences for establishing an on-line monitoring system. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstract 10305.

10257 (GA-A-13126) HTGR FUELS AND CORE DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending August 30, 1974. (General Atomic Co., San Diego, Calif. (USA)). 30 Sep 1974. Contract AT(04-3)-167. 139p. Dep. NTIS $5.45.

The work reported includes studies of reactions between core materials and coolant impurities, basic fission product transport mechanisms, core graphite development and testing, the development and testing of recyclable fuel systems, and physics and fuel management studies. Materials studies include irradiation capsule tests of both fuel and graphite. Experimental procedures and results are discussed and the data are presented. (auth)

10258 (JAERI-M-5661) DELIGHT-2: THE POINT REACTIVITY BURNUP CODE FOR HIGH-TEMPERATURE GAS-COOLED REACTOR CELLS. Shindo, R.; Hirano, M. (Japan Atomic Energy Research Inst., Tokyo). Apr 1974. 53p. (In Japanese). NTIS (U. S. Sales Only).

The DELIGHT code which was developed to analyze the burnup characteristics for cells of graphite moderated reactors with fuel elements composed of coated fuel particles, has been revised to increase the accuracy of calculations. DELIGHT-2 incorporates the following improvements: (1) the doubly space-heterogeneous effect of fuel (dispersion of coated fuel particles in the graphite matrix and regular array of fuel rods in the graphite block) is considered for calculation of the resonance absorption, (2) the chemical binding effect of graphite is taken into account in the scattering of thermal neutrons, (3) the fine distribution of flux in the unit cell can be calculated, and (4) the depletion of ^{10}B with burnup is treated in the reactivity calculation. The DELIGHT-2 code is expected to suffice as a calculational model for the nuclear design of high-temperature gas-cooled reactor cores. (auth)

10259 (LA-5768-MS) INTEGRAL EXPERIMENT DATA FOR HTGR SAFETY STUDIES. Adler, F. T.; Vigil, J. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1974. Contract W-7405-eng-36. 16p. Dep. NTIS $4.00.

The evaluation of the temperature coefficient in HTGR's is based to a considerable extent on the integral experiment data obtained from the Gulf General Atomic (GGA) clean critical experiments and on the High Temperature Lattice Test Reactor (HTLTR) results obtained at Battelle Northwest Laboratories (BNWL) in 1970-71. Apparent disagreements between calculated results and experimental data for HTGR systems containing ^{233}U are summarized; the potential of the LASL HONEYCOMB assembly for obtaining benchmark data for the temperature coefficient in HTGR systems is discussed, and results of preliminary scoping calculations are presented to provide a basis for further considerations of integral experiments. (auth)

10260 CLOSED CYCLE GAS TURBINE PLANT CONTROL SYSTEM. Preinreich, G. F. F. J. (to United Kingdom Atomic Energy Authority). British Patent 1,360,029. 17 Jul 1974. 5p.

A system is described whose aim is to provide a closed cycle gas turbine plant in which control is simplified, particularly during the period immediately following a change in load. The plant comprises a gas compressor, a heat source, the gas turbine, a recuperator and a heat rejection gas cooler. A high pressure gas flow path interconnects the compressor outlet, the heat receiving side of the recuperator, the heat source, and the turbine inlet, and a low pressure flowpath interconnects the turbine outlet, the heat-yielding side of the recuperator, the gas cooler, and the compressor inlet. The high pressure side of the flowplate has two by-pass ducts each arranged to by-pass a controlled fraction of the total gas flow, with the effect of lowering the gas temperature at the heat source inlet and at the turbine inlet. Two turbines may be employed, the first driving the compressor and the second driving an electric generator. Two compressors may also be employed, connected in series, with cooling means between them. The heat source may comprise a nuclear reactor. By coordinated selection of the gas fractions passed by the two by-pass ducts the temperature of the gas leaving the heat source may be maintained constant during load reductions. Alternative methods of operation of the by-pass valves are described. With a gas-cooled reactor as heat source, suitable manipulation of the valves makes it possible to accommodate reduced loads almost instantaneously while the reactor control mechanisms may be left undisturbed during the early part of a transient. (UK)

10261 THE PRESTRESSED CAST IRON PRESSURE VESSEL (PCIV): ITS APPLICABILITY FOR GAS- AND WATER-COOLED NUCLEAR POWER REACTORS AND FOR BURST PROTECTIONS. Beine, B.; Gross, H.; Schilling, F. E. (Siempelkamp Giesserei K. G., Krefeld (F. R. Germany)). Nucl. Eng. Des.; 28: No. 3, 387-399(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The field of applicability of prestressed cast iron pressure vessels in the nuclear power industry is described. Principles of design and construction are discussed. Theoretical analyses are corroborated by results obtained from model testing. Pod boiler versions of the PCIV are introduced for two HTRs. The design of a PCIV for a BWR is proposed. Two concepts of a prestressed cast iron burst protection for steel pressure vessels of a BWR are presented. The advantages of prestressed cast iron structures are listed. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 10270, 10343, 10390, 10391, and 10396.

10262 OARAI ENGINEERING CENTER OF PNC. Kawaguchi, T. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Karyoku Hatsuden; 24: No. 1, 29-38(Jan 1973). (In Japanese).

In the Oarai Engineering Center of Power Reactor and Nuclear Fuel Development Corporation (PNC), power reactor development is proceeding for a fast breeder reactor and an advanced thermal reactor. The former is a LMFBR with sodium cooling, the MONJU, while the latter, the JATR, is heavy-water moderated and boiling light-water cooled type. The following activities and facilities of the Oarai Engineering Center are described: the development of MONJU with testing facilities for sodium, steam generator, safety, and fuel; and the development of JATR, with testing facilities for D_2O criticality, engineering, and safety. (JA).

10263 ANALYSIS OF REACTOR END SHIELDS WITH STIFFNESS AND FOUNDATION VARYING RADIALLY. Ambrose, J. G. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). (1974). vp.

From 2nd symposium on applications of solid mechanics; Hamilton, Ontario (17 Jun 1974).

A novel use of plate elasticity has provided an inexpensive programmed analysis of PHWR end shields. The geometry and loads of the end shield generalize into a problem of linear elasticity. The end shield can be seen as an axisymmetric plate with flexural rigidity, transverse load, and foundation stiffness, all varying with radius. Because the analysis is very general, many other industrial problems can be solved with the method. The method examined circular plates under the action of radially varying load, rigidity, and foundation. The plate is subdivided into annular plate elements whose solutions are known assuming uniformity within each element. The set of integration constants for all solutions is found from the simultaneous satisfaction of all interface and peripheral boundary conditions. The solution is exact for a problem whose properties vary in a piece-wise uniform manner (no concentrated loads). However, when the properties are continuously varying with radius, errors result from property averaging within each annular segment. How the accuracy varies with the number of segments is deduced in a particular case. The reduction of error is confirmed with actual computer results. The programmed analysis with several realistic cases of both foundation and non-foundation problems is illustrated. Previous theoretical and experimental results taken from the literature show very good agreement with the studies. A feature of the analysis is that it is very economical in computation time compared with finite element programs. (auth)

10264 SMALL REACTORS FOR DESALINATION: A NATURAL URANIUM HEAVY WATER MODERATED AND COOLED TYPE FEASIBILITY STUDY. Fouad, H. Y. (Atomic Energy Authority, Cairo). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 4, 9-13(Aug 1974).

Efforts towards the utilization of nuclear power in desalination to satisfy Egypt's long-term water needs considered natural uranium heavy water moderated and cooled reactors as one of the promising prototypes. A feasibility study for a 40 MW(t) pilot plant was conducted, and the main core features were determined. The concept comprised natural uranium metallic fuel, heavy water moderator and coolant in separate circuits, and aluminum alloy cladding and structural material. The design included a parametric investigation to determine optimum configurations. Results are shown giving cell and core details. (auth)

10265 SUITABILITY OF THE STEAM GENERATING HEAVY WATER REACTOR FOR THE POWER REQUIREMENTS OF DEVELOPING COUNTRIES. McKeague, R. (United Kingdom Atomic Energy Authority, Risley, Eng.). Atom (London); No. 215, 200-214(Sep 1974).

From CENTO symposium; Ankara, Turkey (3 Jun 1974).

A description is given of the SGHWR system, with particualr reference to its suitability for the requirements of developing countries, under the following headings: (1) evolution of the SGHWR (2) the 100 MW(e) reactor system at the Winfrith Atomic Energy Establishment (UK)—design description, construction, pre-operational testing and commissioning, operational performance, plant control and shut down, health physics and operating radiation levels, replacement of pressure tubes, turbine plant operation; (3) commercial design; and (4) suitability for desalination plants. Efficiency, and ease and flexibility of operation of the system have been demonstrated by seven years operation of the Winfrith plant. (UK)

Power Reactors, Breeding

Refer also to abstracts 10262, 10305, 10307, 10311, 10328–10330, 10338, 10343, 10347, and 10392.

10266 (ANL-RDP-32) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, SEPTEMBER 1974. (Argonne National Lab., Ill. (USA)). 1 Nov 1974. Contract W-31-109-eng-38. 171p. AT.

Progress is reported in the following areas: (1) EBR-2 operation and testing, (2) Hot Fuel Examination Facility, (3) LMFBR design support, (4) instrumentation and control, (5) fuels and materials development, (6) fast reactor physics, (7) reactor safety analysis and experiments, and (8) GCFR studies. (DG)

10267 (BNWL-tr-130) EXPERIENCE WITH ELECTROCHEMICAL OXYGEN PROBES IN SODIUM LOOPS. Borgstedt, H. U.; Drechsler, G.; Frees, G.; Wittig, G. Translated from Atomwirt., Atomtech.; 19: 357-359(1974). 12p. Dep. NTIS $4.00.

The operational principles of electrochemical oxygen probes are discussed, and experience in the use of this type of instrument to detect oxygen in sodium systems is described. Data obtained with commercially available probes are presented. Calibration, temperature dependence, sensitivity, and radiation effects are discussed together with the application of the probe to monitor oxygen concentrations in LMFBR coolant circuits. (DG)

10268 (HEDL-TME-74-3(Vol. 4)) HEDL QUARTERLY TECHNICAL REPORT, JULY, AUGUST, SEPTEMBER 1974. Volume 4. Engineering and Development. Noordhoff, B. H.; Weber, S. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1974. Contract AT(45-1)-2170. 100p. AT.

Information is presented concerning the testing of Clinch River Breeder Reactor and FFTF components and systems, nondestructive testing engineering, and development of FFTF instrumentation and data processing systems. (DCC)

10269 (JAPFNR-168) EXPERIMENTAL STUDY ON RADIATION SHIELDING CONCRETE UNDER HIGH TEMPERATURE CONDITIONS FOR FAST BREEDER REACTOR. Yamamura, T.; Hozumi, Y.; Isimi, K.; Sugawara, S. (Electric Power Development Co. Ltd., Tokyo (Japan)). Sep 1974. 37p. (PNC-N-251-73-08). Dep. NTIS (U. S. Sales Only) $4.00.

For Power Reactor and Nuclear Fuel Development Corp., Tokyo, Japan.

Neutron shielding materials for fast breeder reactors are exposed to high temperatures in addition to neutron and gamma radiation. Although water is effective for neutron shielding, it is not practical especially in the vicinity of the reactor core because of liquid sodium being used as coolant material. Because of this graphite has been used so far. Serpentine aggregate concrete which contains crystallizing water, has recently been applied for practical use instead of the graphite in some countries. Some fundamental qualities of concrete specimens under non-heated conditions after experiencing high temperature exposure have been measured. The materials of concrete are crushed stone, crushed sand of serpentine rock as aggregates, normal portland cement or alumina cement as binder, and admixtures for improving the nature of these cements. At the high temperature curing age of 91 days, rather desirable characteristics were obtained for five mix-proportions. These five mix-proportions are concrete (J-OCF) with normal portland cement added by fly ash, concrete (J-AC) with alumina cement and concrete (J-ACG) with alumina cement added by admixture of gypsum group for the curing temperature of 90°C, and also concrete (J-OC) with normal portland cement and concrete (J-OCF) with normal portland cement added by fly ash for the curing temperature of 300°C, respectively. (auth)

10270 (MRR-136) ANALYTICAL ONE-DIMENSIONAL ONE-CHANNEL MODEL FOR CALCULATION OF THE FREQUENCY RESPONSE AND STABILITY BEHAVIOR OF SODIUM-COOLED REACTOR INSTALLATIONS. Saedtler, E. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Mar 1974. 108p. (In German). Dep. NTIS (US Sales Only) $8.50.

A one-dimensional, one-channel dynamic model is presented which describes in an analytical form the frequency response and stability behavior of a sodium cooled reactor plant with respect to any perturbations within the primary and secondary coolant system. The theoretical work was based on a reactor plant concept represented by a single coolant channel, a shell-and-tube type counterflow heat exchanger, and the appropriate connecting coolant lines. To make the model applicable for both a fast breeder reactor type (SNR-300, PHENIX, PFR) and a thermal reactor (e.g., the KNK prototype reactor plant at Karlsruhe), two versions of coolant channels had been included in the model. In the case of the fast fuel elements a simple coolant channel was assumed containing a number of cylindrical fuel rods. The lower and upper breeder region of the fuel elements can then be simulated by appropriate choice of the reactivity weighting function and the axial power distribution function. In the case of the KNK fuel element type the cylindrical fuel rods with upward flowing liquid sodium are situated within the annular interspace of two hollow-cylindrical solid-state (ZrH_x) moderator elements. (auth)

10271 OUTLINE OF THE 3RD DESIGN OF MONJU. Doryokuro Giho; No. 9, 63-79(Dec 1973). (In Japanese).

The third design of MONJU was completed in March, 1973, by five companies in Japan. The main purposes of the design were to reflect the recent results of research and development performed at home and abroad, to adjust overall plant design in detail, and to prepare the materials for checking and reviewing as a preliminary to the safety investigation. Major design alterations from the second design were as follows: adoption of dual containment system; adoption of single piping for reactor and primary cooling system; sharing of main primary cooling system by auxiliary core cooling system; and adoption of structure making innermost blanket assemblies exchangeable with core assemblies. Various design parameters are given in a table. Core volume, breeding ratio, and the average burnup of discharged fuel for equilibrium core are 2230 liters, 1.15 and 80.000 MWD/T, respectively. The outlines of core design, reactor structural design, fuel handling system, heat transfer system, steam generator system, turbine generator system, instrumentation system, and radioactive waste disposal system are summarized. This design will be succeeded by the first-stage adjusting design in 1973. (JA)

10272 BURNUP CHARACTERISTICS OF LARGE Pu–Th FAST REACTORS. Buildup of ^{233}Pa. Ohta, M. (Kyushu Univ., Fukuoka). Kyushu Daigaku Kogaku Shuho; 46: No. 6, 701-707(Dec 1973). (In Japanese).

Feasibility of a Pu-Th fast reactor was investigated. The effects on reactivity due to the build-up of ^{233}Pa following burn-up are discussed. The shape and size of the reactor considered were a spherical reactor of 3000 1 core volume, which consists of core, blanket, and reflector. Two systems were considered as models of the reactor. One is (Pu–^{232}Th) core–^{232}Th blanket system (system No. 1), and the other is (Pu–^{238}U) core - ^{232}Th blanket system (system No. 2). Neutron flux was calculated by the RNB code with one dimension, 16 groups, 7 regions. The group constants employed were the YOM set. The constants of ABBN were used under the following assumptions: (1) $\sigma_{FP}(^{233}\mathrm{Pa}) = \sigma_{FP}(^{232}\mathrm{Th})$, $\sigma_c(^{233}\mathrm{Pa}) = \sigma_c(^{232}\mathrm{Th})$; (2) σ_c^{FP} (core) = σ_c^{FP} (^{239}Pu), σ_c^{FP} (blanket) = σ_c^{FP} (^{233}U). The results of calculation show that the breeding potential of ^{232}Th is lower than that of ^{238}U, but it is possible to obtain a large breeding ratio, such as 1.48, when ^{232}Th is used in combination with Pu in the system No. 1. The atomic density of ^{233}Pa and ^{242}Pu come to steady values at the early stage of burn-up. It must be noted that the atomic density of ^{233}Pa in the core is almost same as that of ^{242}Pu. Fast build-up of fission products is seen, and the urgent need of the evalution and arrangement of nuclear data of FP are suggested. Fast consumption of ^{239}Pu in the core of system No. 1 is shown. In the system No. 2, the amount of ^{239}Pu increases a little with burn-up time. The variation of atomic density owing to the change of assumptions in group constants was also investigated. (JA)

10273 STEAM GENERATOR SYSTEM FOR CLINCH RIVER. Skavdahl, R. E.; Tippets, F. E. Nucl. Eng. Int.; 19: No. 221, 857-860(Oct 1974).

Engineering of the steam generator system for the Clinch River Breeder Reactor Plant is nearing completion of the preliminary design phase. The approach for this critical system is directed to achievement of high reliability and availability for plant operation, using equipment designs that also have good potential for economic application in future commercial liquid metal fast breeder reactor plants. The system is described, and details of the intermediate heat exchangers, the steam generator building, and evaporator superheaters are given. The detection of small leaks and measures for counteracting effects of a sodium-water reaction are discussed. Reference is made to some major tests planned in support of the steam generator system. (UK)

10274 CLINCH RIVER REACTOR REFUELLING SYSTEM. Foster, K. W. (Atomics International Div., Canoga Park, CA). Nucl. Eng. Int.; 19: No. 221, 860-862(Oct 1974).

Most of the equipment and facilities are located in the reactor service building, which is adjacent to the reactor containment building. Fuel movement between buildings is accomplished with a heavily shielded ex-vessel transfer machine (EVTM) which is mounted on a gantry. The EVTM with gantry passes through a containment building hatch which is removed for these operations only during reactor shutdown. The sequence of the fuel handling system is outlined. The layout of the refueling facilities is shown and the components are described. (UK)

10275 CLINCH RIVER BREEDER REACTOR PROJECT NUCLEAR STEAM SUPPLY SYSTEM. Jacobi, W. M. Nucl. Eng. Int.; 19: No. 221, 846-850(Oct 1974).

The reference design for the Clinch River breeder reactor plant is described. It is basically a Na-cooled reactor containing a UO_2-PuO_2 core surrounded by a depleted U blanket designed for 975 MW(t) output, to produce a net output of 350 MW(e). The heat transport system is characterised by a piped loop design of three loops and the use of forced recirculation steam generators coupled to a conventional multiple stage regenerative feedwater steam cycle without reheat. Principal parameters are quoted and sketches are included of the reactor and closure head system, the heat transport system, the overall layout of the plant, and the control system. (UK)

10276 ROLE OF THE CLINCH RIVER PROJECT IN THE U.S. LMFBR PROGRAM. Behnke, W. B.; Watson, J. E.; Nemzek, T. A. Nucl. Eng. Int.; 19: No. 221, 835-839(Oct 1974).

A discussion of the Clinch River project in relation to the U.S. liquid metal fast breeder reactor program introduces a special survey comprising a number of articles on the project and a colored fold-out wall chart of the reactor. Clinch River, the first U. S. large scale demonstration breeder nuclear power plant, is to be a 380 MW(e) reactor, designed for a 30 y life and will have an initial breeding ratio of 1.2. Events leading up to the project are discussed. The principal objectives of the demonstration plant program are described and the responsibilities of the authorities and companies involved are explained. Some details are given of siting, staffing, and target schedules. Supporting activities, among which are the FFTF and facilities at the Liquid Metals Engineering Center, are discussed. (UK)

10277 LMFBR FUELS AND MATERIALS DEVELOPMENT. Cunningham, G. W. (USAEC Div. of Reactor Development, Washington, DC). Nucl. Eng. Int.; 19: No. 221, 840-845(Oct 1974).

To fulfil the potential of nuclear power as a contributer to the world's energy problem, it is important, in relation to the LMFBR, to improve the utilization of uranium by reducing the doubling time. Factors which influence the doubling time are discussed. With the aim of attaining high breeding ratios and low specific inventories for LMFBRs, comprehensive programs of development work are planned for reference materials for fuel elements, structural materials, control pins, etc., and also for advanced fuel and absorber materials and core engineering advancements. A fuel recycle program will provide base technology for minimizing ex-reactor inventory time and reprocessing losses. The various programs are discussed. (UK)

10278 A COMPUTATION METHOD FOR THE STEADY STATE THERMOHYDRAULIC ANALYSIS OF FUEL ROD BUNDLES WITH SINGLE PHASE COOLING. Nijsing, R.; Eifler, W. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Nucl. Eng. Des.; 30: No. 2, 145-185 (1974).

A detailed description is given of a thermohydraulic subchannel analysis of multirod fuel bundles with single phase cooling. Both grid spacers and helical wire spacers are considered. An analytical mathematical approach has been adopted for computing the axial distribution of subchannel coolant temperatures. The computation method has been applied to fast reactor fuel elements with liquid metal cooling. Intersubchannel heat transport mechanisms are discussed in detail. Numerical results center on the effect a lateral power gradient has on the temperature field in a hexagonal fast reactor fuel rod assembly. An important result obtained is that for large hexagonal fuel rod assemblies intersubchannel heat transport does not contribute to the attenuation of circumferential flow duct temperature differences. This holds both for assemblies with grid spacers and those with helical wire spacers. (auth)

10279 DIANA–A FAST AND HIGH CAPACITY COMPUTER CODE FOR INTERCHANNEL COOLANT MIXING IN ROD ARRAYS. Hirao, S.; Nakao, N. (Hitachi Ltd., Ibaraki (Japan). Hitachi Works). Nucl. Eng. Des.; 30: No. 2, 214-222(1974).

A mathematical model and digital computer program are presented for the subchannel thermal and hydraulic analysis of sodium-cooled fast reactor fuel assemblies. The newly developed FORTRAN-IV computer code "DIANA" is much more useful than many other subchannel mixing analysis codes, especially for large size fuel assemblies which contain more than about 80 subchannels, and for assemblies undergoing swelling and thermal bowing which cause deformed coolant flow ducts, because of high computing speed, reduction of necessary core memory and accurate solution by momentum conservation. Numerical solutions are presented for a deformed rod bundle which contains 179 subchannels. (auth)

10280 CLINCH RIVER BREEDER REACTOR PROJECT BALANCE-OF-PLANT DESIGN. McPherson, S. Nucl. Eng. Int.; 19: No. 221, 863-865(Oct 1974).

A description is given of the main design features of the major mechanical and electrical systems associated with the turbine-generator. These include the main and auxiliary steam systems, feedwater and condensate system, and the heat rejection system. (UK)

Research, Test, and Experimental Reactors

Refer also to abstracts 10266, 10268, 10304, and 10394.

10281 (AECL-4584) FAST NEUTRON FACILITIES FOR WR-1. Crosthwaite, J. L. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Aug 1974. 30p. Dep. NTIS (U. S. Sales Only) $4.50. AECL $1.00.

In CANDU reactors, the prime source of irradiation damage to the most critical core components is from fast neutrons (energy ≥ 1 MeV). Irradiation damage affects nuclear power reactor economics since reactor core components must be replaced when they can no longer meet the exacting standards that have been set by the nuclear industry for their safe operation. To study the effects of fast neutron irradiation on materials, at an accelerated rate and under controlled conditions, special facilities have been developed for some of AECL's research reactors. New innovations in fuel and hardware design were needed for the successful development of such facilities for WR-1, a high temperature, heavy-water-moderated organic-cooled reactor. The WR-1 facilities, their development, capabilities, and special facility rigs used for fundamental and applied research are described. (3 references) (auth)

10282 (ANL-8108) MEASUREMENT OF THE ADSORPTION COEFFICIENTS OF ARGON ON ACTIVATED CHARCOAL. Panek, A. F.; McPheeters, C. C.; Welborn, H. C. (Argonne National Lab., Ill. (USA)). Oct 1974. Contract W-31-109-eng-38. 17p. Dep. NTIS $4.00.

The adsorption coefficients for argon on activated coconut charcoal have been measured to aid in the prediction of the behavior of argon in a system for monitoring fuel-cladding failures. In this study, two separate procedures were used to determine the dynamic adsorption of argon on activated coconut charcoal at temperatures from −78 to 140°C. The adsorption isobars for argon obtained by the two methods are in close agreement; moreover, values for xenon and krypton determined by the same methods agree well with values published in the literature. 13 references. (auth)

10283 (BARC-724) DETERMINATION OF THE RATE OF FORMATION OF NITRIC ACID IN CIRUS MODERATOR (D_2O) SYSTEM DUE TO IRRADIATION OF NITROGEN IN MODERATOR COVER GAS (HELIUM). Ganapathy Raman, S.; Subramanian, G.; Vartak, D. G. (Bhabha Atomic Research Centre, Bombay (India)). 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

The rate of formation of nitric acid in the heavy water system of CIRUS due to irradiation of nitrogen (0.02% v/v) in helium was determined by estimating the build-up of nitrate ion concentration in heavy water after valving out the ion exchanger. The rate is also computed from the increase in specific conductivity as read by the on-line conductivity-meter of the heavy water system. The results are in close agreement with those extrapolated from the reported value in NRX Reactor, Canada, at higher N_2 content. (auth)

10284 (ICP-1058) REVISED FISSION YIELD DATA FOR LIGHT AND HEAVY MASS PEAKS FOR FAST REACTOR EBR-I FISSIONED URANIUM-235. Maeck, W. J.; Emel, W. A.; Tromp, R. L. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Oct 1974. 6p. Dep. NTIS $4.00.

Several computational errors in originally reported fission yield data for EBR-I fissioned ^{235}U have been corrected and revised data are reported for masses 83 to 116 in the light mass peak and 118 to 157 in the heavy mass peak. Data for cerium, neodymium, and samarium nuclides are substantiated by recent measurements on newly dissolved EBR-I ^{235}U fuel. (auth)

10285 (IS-3483) AMES LABORATORY REACTOR OPERATOR TRAINING PROGRAM. Gurganus, E. K. (Ames Lab., Iowa (USA)). Aug 1974. Contract W-7405-eng-82. 35p. Dep. NTIS $4.75.

The Ames Laboratory Research Reactor's (ALRR) Reactor Operator Training Program (ROTP) is described, and philosophies and policies concerned with interim training, initial training, qualification, retaining, requalification, and certification of the ALRR operators are clarified. (auth)

10286 (ORNL-TM-4761) BULK SHIELDING FACILITY QUARTERLY REPORT, APRIL–JUNE 1974. Hurt, S. S. III; Lance, E. D.; Thomas, J. R. (Oak Ridge National Lab., Tenn. (USA)). Dec 1974. Contract W-7405-eng-26. 20p. Dep. NTIS $4.00.

The BSR has remained shut down throughout the quarter for pool repairs. Some radioactive materials were lowered into the pool deep pit, the reactor fuel was transferred to the OGR canal storage and the pool water level was lowered to the pool floor. Defective places in the concrete pool walls are being chipped, grouted and sealed in preparation for painting. Pool repairs accounted for 100% of the downtime. The PCA was operated 12 days during this quarter. (auth)

10287 (PTB-FMRB-55) PROGRESS REPORT ON THE OPERATION AND RADIATION PROTECTION OF THE BRAUNSCHWEIG RESEARCH AND MEASUREMENT REACTOR FOR THE YEAR 1973. Heintz, W.; Siegel, V. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany). Forschungs- und Messreaktor). Aug 1974. 44p. (In German). Dep. NTIS (US Sales Only) $5.25.

The operation of the FMRB Reactor and radiation protection work in 1973 are reported. No serious problems arose in 3460 hours of operation. (auth)

10288 ITALIAN PROGRAM FOR THE ESSOR REACTOR. Barabaschi, S. Com. Naz. Energ. Nucl., Notiz.; 20: No. 8-9, 30-90(1974). (In Italian).

A detailed description of the ESSOR reactor and associated research and test facilities is provided. Specifications and characteristics are listed, and components and structure are illustrated in detailed prints and photos. Planned additions to the research facilities are discussed, and completed and planned research projects are described. (DG)

10289 DYNAMICS OF REPETITIVE-ACCELERATOR FAST-PULSED REACTOR. Yoshikawa, H.; Wakabayashi, J. (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 11: No. 4, 125-140(Apr 1974).

A promising new approach to dynamics problems relevant to the repetitive pulsed reactor is proposed, in which the matrix iterative method is utilized to describe dynamic behavior during one pulse cycle, as well as between adjacent pulse cycles. The conditions requisite for realizing pulsed criticality and the state of stationary repetitive pulsed operation are derived in simple expressions for the repetitive Accelerator Fast-Pulsed Reactor (AFPR). The accurate neutron pulse shape is easily obtained by this method, whatever the shape of the reactivity pulse may be. A core dynamics model of the AFPR is also developed by combining thermohydraulic considerations with the neutron dynamics. Quantitative examination of the design parameters of the Japan Linac Booster (JLB) based on dynamics considerations provides proof of the validity of the JLB design concept. It is noted, however, that the high sensitivity of the mean reactor power and the peak neutron density to changes in reactivity, as well as the severe thermal shock to the fuel elements that would be induced by accidents due to an excessively large reactivity would make it essential to ensure high precision, promptness, and reliability in the system of reactivity control. The possibility is pointed out of improving the S/N ratio by varying the speed of the rotary reflector. (auth)

10290 INHERENT NOISE ANALYSIS INVESTIGATION ON THE EXPERIMENTAL BREEDER REACTOR II. Ebert, D. D. (Argonne National Lab., IL). Nucl. Sci. Eng.; 55: No. 4, 470-476 (Dec 1974).

The major objective of this investigation was to study the possibility of measuring dynamic characteristics of the Experimental Breeder Reactor II (EBR-II) by an analysis of the inherent fluctuations at steady state. Subsidiary objectives were to devise a means whereby detailed signature analyses could be obtained on a routine basis and to interpret these signatures. Relatively simple noise models were developed for the EBR-II which aided in the interpretation of the measured signatures. From the interpretation, it appears that it is not possible to measure the power to reactivity transfer function using inherent noise analysis with the existing EBR-II detection equipment. There exists, however, the possibility that this transfer function, and transfer functions of a similar type, may be measured if thermocouples and flowmeters of a different design and/or location are implemented. Detailed, broad frequency range signatures of two neutron detectors have been obtained at low and high power levels for one run. Also, signatures of a single neutron detector have been processed for several runs. These signatures changed in a complicated fashion from run to run. (auth)

10291 MEASUREMENT AND ANALYSIS OF PARAMETERS IN TIGHT ^{232}Th–^{235}U AND ^{232}Th–^{233}U LATTICES MODERATED WITH HEAVY WATER. Hardy, J. Jr.; Volpe, J. J.; Klein, D. (Westinghouse Electric Corp., West Mifflin, PA). Nucl. Sci. Eng.; 55: No. 4, 401-417(Dec 1974).

Parameter measurements and calculations in two D_2O-moderated thorium–uranium critical assemblies are described in detail. The first, designated ETA-I, contained 6.7 wt % $^{235}UO_2$–ThO_2 fuel rods 0.66 cm in diameter, clad in aluminum. The second assembly, ETA-II, contained 3.0 wt % $^{233}UO_2-ThO_2$ fuel rods 1.09 cm in diameter, clad in Zircaloy-2. A relatively hard spectrum was obtained in both lattices. Because leakage was small and the central flux spectra were closely asymptotic, these assemblies provided a cleanly analyzable test of important reaction cross sections. Parameters measured in ETA-I were ^{232}Th fission/^{235}U fission (δ^{02}), ^{232}Th capture/^{235}U fission (CR*), and epithermal/thermal-neutron ratios for ^{235}U fission (δ^{25}) and ^{232}Th capture (ρ^{02}). Corresponding measurements with ^{233}U were made in ETA-II; δ^{02} was measured directly in fuel and ThO_2 pellets by observing specific fission product gamma rays with a high resolution Ge(Li) detector. With this system, ^{232}Th capture gamma-ray activity was also measured directly in a fuel pellet. The epithermal/thermal-neutron ratios were measured by the thermal-neutron subtraction technique relative to ^{164}Dy, and CR* was measured relative to its thermal-neutron value in a very soft spectrum. A three-dimensional adjoint Monte Carlo program was used to calculate foil flux perturbations and cadmium cutoff energies. Supplemental fast/epithermal-neutron spectrum comparisons were made between the ETA assemblies and the 4/1 TRX critical assembly by means of the following activation detectors: $^{197}Au(n,\gamma)$, $^{55}Mn(n,\gamma)$, $^{235}U(n,f)$, $^{238}U(n,f)$, $^{27}Al(n,\alpha)$, and $^{96}Zr(n,\gamma)$. The lattices were analyzed explicitly with a full energy range Monte Carlo program having a detailed cross-section description. ENDF/B Version 2 and light-water breeder reactor (LWBR) cross-section sets were used. On the whole, agreement with experiment was very good. (auth)

10292 OSCILLATORY MEASUREMENTS IN STEK. Smit, J. (Stichting Reactor Centrum Nederland, The Hague). Atoomenergie Haar Toepass.; 16: No. 9, 191-199(Sep 1974). (In Dutch).

The coupled fast-thermal critical facility (STEK) which has been operating at the Petten Laboratories since October 1973 is briefly described. Four series of oscillatory measurements (STEK 1000, 2000, 3000 and 4000) on various U/Pu fuel-element assemblies are reported. Detailed results for neutron spectra are presented graphically. (NL)

10293 EXPERIMENTS WITH THE KSTR. Kersten, J. A. H.; van der Veer, J. H. C. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). Atoomenergie Haar Toepass.; 16: No. 9, 200-204(Sep 1974). (In Dutch).

Previously reported technical data is summarized for the Kema Suspension Test Reactor (KSTR). Detailed measurements of reactivity fluctuations, with associated power and temperature surges, are reported under various simulated fault conditions. (NL)

Production and Materials Testing and Processing Reactors

10294 (AD-781346) REACTOR DOSIMETRY WITH DIODES, POCKET DOSIMETERS, AND PAIRED CHAMBERS. Tumbraegel, G. E.; Shosa, D. W.; Verrelli, D. M. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Oct 1973. 20p. (AFRRI-TN-73-16). NTIS $3.00.

Paired ionization chambers with nominal volumes of 0.5 cc have been used for measuring the neutron and gamma ray dose components in different AFFRI-TRIGA reactor fields. The results of the measurements have been compared with measurements made with other dosimetry systems such as wide based silicon diodes and pocket dosimeters. The saturation behavior of the pocket dosimeters has been tested by exposures with the AFRRI linac. Results indicate that the pocket dosimeters have a lower sensitivity to fast neutrons than to gamma rays, which could probably be improved, and, more important, that the dose rate dependence is very strong. On the other hand, the silicon diode is a very attractive device for measuring neutron doses because of its simplicity of readout, its negligible gamma response and its neutron energy response which does not change if a small shift in the neutron energy spectrum occurs. (auth)

10295 (KFK-2037) DEVICE FOR THE REPLACEMENT OF UO_2-PuO_2 TEST FUEL RODS WITH CLADDING DEFECTS AT THE FR2 REACTOR. Jannakos, K.; Hain, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Reaktorbetrieb und Technik). Aug 1974. 19p. (In German). Dep. NTIS (US Sales Only) $4.00.

Special devices have been developed for handling plutonium-bearing fuel element specimens with planned and unplanned cladding defects irradiated in a steam contamination loop at FR2. These special devices allow work required for the replacement of fuel element specimens to be performed while protecting the reactor environment and its standard handling equipment from alpha contamination. The tasks, implementation, and experience obtained in the use of the special devices are described. (auth)

Propulsion and Package Reactors

Refer also to abstract 10356.

10296 (JNS-11) CONSTRUCTION OF THE CREW-TRAINING SIMULATOR FOR N. S. MUTSU. (Japan Atomic Energy Research Inst., Tokyo). Jun 1973. 23p. (In Japanese). NTIS (U. S. Sales Only).

The crew-training simulator for the nuclear-powered ship, MUTSU, which was designed and constructed by Mitsubishi Atomic Power Industry, Inc., is described from the standpoints of design specifications schedule of construction, factory inspection, and training of instructors and maintenance personnel. The purpose of the simulator is to train ship crews efficiently for the operation of the MUTSU reactor. It simulates the actual plant, with high fidelity sensing. It consists of a central control panel including the part for logical operation, an instructor's panel, an analog computer, and voltage regulation equipment. (JA)

10297 (LIB/Trans-537) NUCLEAR ENERGY: TRADING SHIPS. Technical and Economic Considerations. 1974. Translation by J. B. Hopkinson of DEU-73-30. 42p. Dep. NTIS (US Sales Only) $5.25.

Economic and technical developments in maritime transport are dealt with, and some reasons are given for the use of nuclear propulsion for merchant ships. The experience gained so far with nuclear ship reactors is illustrated by giving details of the operation of the N. S. Lenin, Savannah, Otto Hahn, and Mutsu. Some further topics discussed in this review are technical aspects of nuclear ships, the safety of such ships, legal and economic aspects, and the establishment of time schedules up to the operation of nuclear powered merchant ships. (auth)

10298 (Y-B-65-257) PHOTOGRAPHS OF THE "A" TEST SECTOR AND COMPONENTS AFTER THERMAL CYCLING. Waldrop, F. B. (Oak Ridge Y-12 Plant, Tenn. (USA)). 9 Feb 1959. Contract W-7405-eng-26. 42p. Dep. NTIS $5.25.
Declassified 12 Nov 1974.

Photographs taken during inspection of a test segment of the General Electric aircraft reactor (XMA-1) side shield are presented. (DG)

10299 (Y-B-65-278) INSPECTION OF "A" TEST SECTOR AFTER THERMAL CYCLING. Hamill, C. W.; Rudd, J. P.; Blackett, F. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 21 Apr 1959. Contract W-7405-eng-26. 43p. Dep. NTIS $5.25.
Declassified 12 Nov 1974.

The "A" Test Sector is a 45° segment of the side shield for the General Electric Company's nuclear aircraft reactor (XMA-1). The all-metal shell was fabricated by the Budd Company of Philadelphia, Pennsylvania, and shipped to the Y-12 plant at Oak Ridge, Tenn., with one side open. The Y-12 Plant fabricated and installed the lithium hydride shapes, closed the open side, and outgassed the sector at 800°F for 42 hours. After leak checking, the sector was shipped to Wright Air Development Center for thermal cycling tests. Upon completion of these tests, the sector was returned to Y-12 for disassembly and inspection. This consisted of making various measurements of the outside hull, the salt cavities, and the salt itself, and comparing these measurements with measurements made prior to testing. In addition, all thermocouples were checked for continuity, the helium leak rate from the salt cavities was determined, the leaks from the salt cavities were located, pressure-deflection tests were made on the metal shell, chemical analyses were made where indicated, and any unusual conditions or deformations were noted. (auth)

10300 PROSPECTS FOR THE NUCLEAR PROPULSION OF MERCHANT SHIPS. The 8th Blackladder Lecture. Edwards, J. (Royal Naval Coll., Greenwich, Eng.). J. Inst. Nucl. Eng.; 15: No. 4, 99-113(Jul 1974).

A survey of the subject is made under the following headings: historical background; present state of the project and trends; tanker and container ship developments; effects of energy crisis; accident statistics and safety in nuclear ships; and other factors influencing the adoption of nuclear power for merchant ship propulsion. (UK)

10301 NUCLEAR PROPULSION: AN EPILOGUE. Grey, J. (American Inst. of Aeronautics and Astronautics, Inc., New York). AIAA (Amer. Inst. Aeronaut. Astronaut.) Stud. J.; 11: 4-7(Dec 1973).

A review is presented of NASA efforts concerned with the development of propulsion systems based on nuclear fission. Work regarding such systems began in 1945 and was discontinued on January 9, 1973. The U.S. spent about 3 billion dollars for the various programs connected with this work. Almost half of the funds were used for research and development on nuclear rockets. The bulk of the remainder was spent on projects related to nuclear propulsion of aircraft. Other projects were concerned with nuclear ramjet engines, high-speed airbreathing missiles, and the generation of electric power for spacecraft propulsion. The various programs involved are examined, giving attention to the reasons which led to the discontinuation of the projects before final success was attained. Results connected with the work have found applications in various fields or might provide the basis for future technological advances. (IAA)

Reactor Safety and Environmental Aspects

Refer also to abstracts 8320, 8321, 8325, 8612, 8859, 8873, 8876, 8952, 10420, and 10421.

10302 (AD-732671) TECHNOLOGICAL RISK VERSUS NATURAL CATASTROPHE. Libby, L. M. (Rand Corp., Santa Monica, Calif. (USA)). Mar 1971. 7p. (P-4602). NTIS $3.00.

The risk of death from unavoidable natural catastrophes is compared with risk of death attributable to the electrical industry (including risk from nuclear power). The unavoidable natural catastrophes considered are death from meteors, from climatic deterioration caused by changes in amount of sunlight reaching the earth, and from supernovas. Such comparisons may help government agencies balance public risks against public benefits in planning for new technologies. (auth)

10303 (AD-782648) DECISION ANALYSIS FOR THE SITING OF NUCLEAR POWER PLANTS: THE RELEVANCE OF MULTIATTRIBUTE UTILITY THEORY. Keeney, R. L.; Nair, K. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1974. Contract N00014-67-A-0204-0056. 30p. NTIS $3.25.

The necessity for improved decision making concerning the siting and licensing of major power facilities has been accelerated in the past decade by the increased environmental consciousness of the public and by the energy crisis. Along with the relatively objective economic and engineering concerns, clearly the more subjective factors involving safety, environmental, and social issues are crucial to the problem. Hence, the professional judgments and knowledge of experts in these areas should be used in analyses of siting decisions. An approach for formally articulating the experts' judgments and the decision makers' preferences, both of which are clearly subjective, and processing these along with the more objective considerations in a logical manner to acquire the implications for decision making is advocated. (auth)

10304 (ANL-7471(Add.1)) SPECIFICATIONS AND RESULTS OF A DESIGN-BASIS-ACCIDENT CALCULATION FOR ZPPR. Addendum to ANL–7471, Final Safety Analysis Report on the Zero Power Plutonium Reactor (ZPPR) Facility. Hess, A. L.; Thalgott, F. W. (Argonne National Lab., Ill. (USA)). Sep 1974. Contract W-31-109-eng-38. 26p. Dep. NTIS $4.00.

The Zero Power Plutonium Reactor (ZPPR) is a critical facility operated by Argonne National Laboratory in support of the AEC's Liquid Metal Fast Breeder Reactor Development Program. The Final Safety Analysis Report (FSAR) for ZPPR (ANL-7471) reported the results of excursion calculations for hypothetical accidents in simulated metallic-fueled, 1000- and 6000-liter, one-zone cores. Such analyses demonstrated the design capability of the ZPPR containment structure and were designated the Design Basis Accident (DBA). An analysis carried out for an excursion of more serious consequences for a 6000-liter, two-zone core, simulating an LMFBR fueled with a UO_2–PuO_2 mixture and using a more toxic plutonium isotopic mixture is presented. Postulations and procedures used in the analysis were the same as prescribed for the DBA in the FSAR. Although the new off-site dose calculated is higher by a factor of seven than the dose in the FSAR DBA, it is still a fraction of the AEC-permitted occupational burden. Furthermore, the analysis confirms the capability of the containment structure for a more energetic excursion than in the FSAR DBA, and shows again that operation of the ZPPR poses no unacceptable risk. 4 references. (auth)

10305 (ANL-8102) TRITIUM AND NOBLE-GAS FISSION PRODUCTS IN THE NUCLEAR FUEL CYCLE. I. Reactors. Trevorrow, L. E.; Kullen, B. J.; Jarry, R. L.; Steindler, M. J. (Argonne National Lab., Ill. (USA)). Oct 1974. Contract W-31-109-eng-38. 81p. Dep. NTIS $7.25.

A review of the behavior of tritium and noble-gas fission products in nuclear reactors is presented. The sources of tritium considered include fission and activation of poisons and impurities in coolants. The noble gases included in this review are limited to fission products, with emphasis on the long-lived species. Reactor types surveyed include light water reactors, high-temperature gas-cooled reactors, and liquid-metal-cooled fast breeder reactors. Data indicative of the normal operating procedures have been expanded to provide estimates of the quantities of tritium and noble gases and their diluents expected at various points along the flow path for both gaseous and liquid waste streams. Data are normalized to an energy of 1000 MWe-yr to permit comparison with present-generation reactors. (auth)

10306 (BN-TOP-3(Rev. 2)) PERFORMANCE AND SIZING OF DRY PRESSURE CONTAINMENTS. (Bechtel Power Corp., San Francisco, Calif. (USA)). Nov 1974. 61p.

Functional design and accident performance characteristics of dry pressure containments are established using analytical techniques and design parameter selection methods adopted by Bechtel Power Corporation for light-water reactor nuclear power plant containments. The analytical techniques employed to predict thermodynamic performance during postulated loss-of-coolant accidents and the models and assumptions treated in the Bechtel containment analysis computer program COPATTA are given. A typical pressurized water reactor containment transient is analyzed to illustrate the methods established. Parametric studies are provided to demonstrate the sensitivity of the containment performance to certain input parameters. (auth)

10307 (CEA-CONF-2698) USE OF SMALL ON-LINE COMPUTERS IN THE PROTECTION SYSTEMS OF FAST REACTORS. Grisollet, J.; Quenee, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1974. 28p. (In French). (CONF-740477-1). Dep. NTIS (US Sales Only) $4.50.

From meeting of specialists on the use of reliability techniques designed for nuclear installations; Liverpool, UK (8 Apr 1974).

The multiplicity of the physical measurements to be considered in order to assure the protection of fast reactors poses problems which only computers can resolve. After a presentation of the existing French developments in this area, an analysis is made of the reliability-availability aspects and the standards. From this viewpoint the small industrial computers, reserved to the function of protection, are the most adapted in the present state of development. The experience acquired with them and the resulting reliability data confirms their suitability for on-line protection. Test possibilities designed to improve the reliability of the system are proposed. A new structure best satisfying the present needs in a protection system is deduced. (tr-auth)

10308 (CENPD-149) REVIEW OF REACTOR SHUTDOWN SYSTEM (RPS DESIGN) FOR COMMON MODE FAILURE SUSCEPTIBILITY. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Nov 1974. 175p.

A review of Combustion Engineering's Protective System (RPS Design) has been made with the aim of identifying areas that might be particularly vulnerable to common mode failures. The study encompassed primarily the equipment furnished by C–E, but also considered the effects of balance of plant equipment. The systematic approach which was utilized assumed various types of common mode failures individually in all reactor shutdown system components, evaluated the safety consequences of such failures, and postulated potential reasons for the common mode failure. The resulting list of potential common mode failures included many items which have satisfactory mitigating factors or are considered improbable in view of past history and engineering judgement. Thus, some failures, after individual consideration, have been adjudged not "particularly vulnerable" and not deemed to represent a realistic safety problem. A sizeable list of potential common mode failures remains, including those caused by events such as miscalibration, operator error, excessive environmental conditions, electric bus problems, or layout of equipment within a plant. These specific items are enumerated. A review by personnel of the individual plants involved is required to evaluate the possibility and potential of each of these items. (auth)

10309 (COO-2152-13) INVESTIGATION OF PRESSURE DROPS AND HEAT TRANSFER COEFFICIENTS FOR LOSS OF COOLANT EVALUATIONS. Quarterly Progress Report, July 1974–September 30, 1974. Weisman, J. (Cincinnati Univ., Ohio (USA). Dept. of Chemical and Nuclear Engineering). 1974. Contract AT(11-1)-2152. 25p. Dep. NTIS $4.25.

Research progress in experiments on pressure drop and heat transfer phenomena of importance during a loss of coolant accident is reported. The experiments include: (1) transient pressure drop investigations, (2) two-phase pressure drop and flow pattern studies, and (3) transition boiling and reflooding heat transfer tests. (JWR)

10310 (GEAP-13317-07) BWR BLOWDOWN HEAT TRANSFER. Seventh Quarterly Progress Report, January 1–March 31, 1974. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Mar 1974. Contract AT(04-3)-189. 62p. Dep. NTIS $5.45.

Two-Loop Test Apparatus (TLTA) startup testing has been completed. System flow performance under both steady-state and pump trip transients has been measured. A series of blowdown tests has been completed using an unheated bundle. The 49-rod bundle assembly has been completed. A method to calculate heat transfer coefficients from measured heater rod temperature data has been developed. (auth)

10311 (GEAP-13923-7) SAFETY ENGINEERING SEVENTH QUARTERLY REPORT, FEBRUARY–APRIL 1974. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Jun 1974. Contract AT(04-3)-893. 22p. AT.

The purpose of the Safety Engineering Task (TA893-2) is: (1) to bring into sharp focus both the requirements for specific technical information related to LMFBR safety, and the results of previous studies, wherever performed; (2) to recommend to AEC-RRD a course of action which will provide the information still required. The existing LMFBR national safety development program includes both analytical and experimental programs. The Safety Engineering Task utilizes the results of these programs to evaluate their applicability to LMFBR conditions. This goal is obtained by direct use of nationally developed accident-analysis codes and by active participation in the evaluation of safety-related experimental data through both: (1) round-robin analyses of current experimental tests involving ANL and HEDL; (2) independent review and analysis of existing experimental tests. The results of these activities are in the form of correlations of existing data and recommendations on future directions for safety development experimental programs. The results of fuel motion studies are presented. (6 references) (auth)

10312 (MRR-137) CRITICAL MASS FLOW RELATIONS ON THE BASIS OF PUBLISHED EXPERIMENTAL RESULTS. Schally, P. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Apr 1974. 62p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

Theoretical and experimental investigations of critical mass flow rates of subcooled and saturated water as well as a two-phase mixture are discussed. Commonly-used models are investigated and their theory is described. Experiments made by several authors are considered. Particular emphasis is placed upon influence of such parameters as pressure and geometry of the nozzle and the pressure vessel. (auth)

10313 (NP-20189) NATIONAL ENVIRONMENTAL STUDIES PROJECT: COMPILATION AND ANALYSIS OF DATA ON OCCUPATIONAL RADIATION EXPOSURE EXPERIENCED AT OPERATING NUCLEAR POWER PLANTS. Pelletier, C. A.; Simmons, L.; Barbier, M.; Keller, J. H. (SAI Services, McLean, Va. (USA)). Sep 1974. 107p. Atomic Industrial Forum, New York $7.00.

For Atomic Industrial Forum, Inc.

An attempt was made to identify the major sources contributing to occupational radiation exposure at operating nuclear power plants and to compile the occupational radiation exposure associated with certain sources during operation and maintenance at these plants. The methods used are discussed and data obtained from 8 BWRs and 6 PWRs are presented. (JWR)

10314 (ORNL-NSIC-114) ANNOTATED BIBLIOGRAPHY OF SAFETY-RELATED OCCURRENCES IN NUCLEAR POWER PLANTS AS REPORTED IN 1973. Scott, R. L.; Gallaher, R. B. (Oak Ridge National Lab., Tenn. (USA)). Nov 1974. Contract W-7405-eng-26. 390p. Dep. NTIS $15.00.

All abnormal occurrences in nuclear power plants reported in 1973 are reviewed and summarized. The review, which covers 1053 reports of safety-related occurrences, should provide insight as to where additional effort can be expended to improve operations in nuclear power plants. The individual reports, abstracted by the Nuclear Safety Information Center, concern incidents and failures, design or construction deficiencies, and noncompliance citations for license violations. A bibliography is included which contains 100-word abstracts of each incident. For convenience, the bibliography is organized as to type of facility or operation, as follows: boiling-water reactors; pressurized-water reactors; non-water-cooled power reactors; and reactors, general. Also, a key-word index and a permuted title index are provided for each section. (auth)

10315 (ORNL-TM-4729(Vol. 2)) QUARTERLY PROGRESS REPORT ON REACTOR SAFETY PROGRAMS SPONSORED BY THE DIVISION OF REACTOR SAFETY RESEARCH FOR JULY–SEPTEMBER 1974. II. Heavy-Section Steel Technology Program. Whitman, G. D. (Oak Ridge National Lab., Tenn. (USA)). Nov 1974. Contract W-7405-eng-26. 97p. Dep. NTIS $5.45.

Information on the heavy-section steel technology program for water cooled reactor pressure vessels is presented concerning fracture mechanics analyses and investigations, effect of high-temperature primary reactor water on the subcritical crack growth of reactor vessel steel, investigations of fracture toughness of irradiated ASTM-A533 steels, failure testing of 6 inch-thick intermediate test vessels, and thermal shock investigations. (DCC)

10316 (RISO-M-1742) DESIGN ERRORS IN NUCLEAR POWER PLANT. Taylor, J. R. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sep 1974. 76p. Dep. NTIS (US Sales Only) $7.00.

Abnormal occurrences in nuclear power plant are classified and studied statistically, in order to investigate some aspects of the design error problem. The objective of the study is to discover what techniques would be useful in reducing the number of design errors in power plants. (auth)

10317 (RT/ING-(74)21) ALBE: PROGRAM FOR THE CALCULATION OF SEISMIC VIBRATIONS IN LINEAR ELASTIC ELEMENTS. Lelli, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jul 1974. 49p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.50.

The ALBE computer program was written in order to perform seismic analysis of uniform beams variously constrained. The program, written in FORTRAN IV language for IBM 360/44, can be used for natural frequencies, displacements, bending moments and shears computation; the first five vibration modes of the beam are calculated; program results are automatically plotted. As an example, the El Centro (California, 1940) earthquake is considered. (auth)

10318 (RT/ING-(74)24) POST BURN-OUT HEAT TRANSFER (ATTAINABLE PRECISION LIMITS OF THE MEASURED COEFFICIENT). Cumo, M.; Urbani, G. C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jul 1974. 52p. Dep. NTIS (U. S. Sales Only) $5.75.

The measure of post burn-out heat transfer coefficient is subject to an intrinsic, experimental error which depends on the experimental facility and on the whole instrumentation chain. Obviously, the experimental margin of uncertainty reflects on all the proposed heat transfer correlations. To investigate this experimental margin four heat transfer Laboratories, belonging to the European Two-Phase Flow Group, i.e., the Technology Division of the Euratom CCR of Ispra, the Danish Atomic Energy Commission (AEK) Laboratory of Risö jointly with the Royal Institute of Technology (KTM) of Stockholm, the EDF Laboratory of Chatou and the A. B. Atomenergy Laboratory of Studsvik have performed the same post burn-out heat transfer research in the same operation conditions and with identical test sections. All the experimental results were sent to the Laboratorio Tecnologie Reattori of the CNEN, Rome, where they were compared and discussed. The data, together with some conclusions which may be drawn from them, are presented. (auth)

10319 (SZS-157, pp 193-198) PROBLEMS IN PROVING THE MAINTENANCE OF RADIATION PERMISSIBLE VALUES IN THE CASE OF DAMAGE TO A NUCLEAR POWER PLANT. Moebert, K. (Institut fuer Kraftwerke Betriebsteil, Berlin). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The damage limiting values and the safety precautions are briefly considered. The uncertainties connected in the evaluation of dangers from damage to nuclear power plants are discussed from the viewpoint of the accumulation of fission products in the space between fuel and can, contribution of damaged fuel elements to the total possible danger, and leakage into the atmosphere of fission products. The evaluation of the calculations made in each of these cases indicates that the safety devices of a nuclear power plant would contain the accident, but the difficulty lies in proving this. (JSR)

10320 (WASH-1338) BWR WASTE GAS TREATMENT SYSTEM DOSE EVALUATIONS UNDER UPSET CONDITIONS. Final Report. Dyer, N. C.; Schultz, R. J.; Killian, E. W.; Baston, J. E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). May 1974. 73p. Dep. NTIS $5.45. GPO $1.40.

A compilation of the important interacting parameters used in defining the off-site dose from an off-gas system accidental release is presented. (JWR)

10321 (WCAP-8265) WESTINGHOUSE MASS AND ENERGY RELEASE DATA FOR 3800 Mwt NSSS CONTAINMENT DESIGN. Shepard, R. M.; Mark, R. H.; Julian, H. V. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Sep 1974. 127p.

The methods concerning the release of mass and energy to the containment under the assumption of a primary pipe break are presented. The methods as presented are intended for use when determining maximum containment pressures following a loss of coolant accident. (12 references) (auth)

10322 (XN-235) EXXON NUCLEAR EVALUATION MODEL FOR BWR LOSS OF COOLANT ACCIDENTS. Nechodom, W. S.; Steves, L. H. (Exxon Nuclear Co., Richland, Wash. (USA)). Oct 1974. 32p.

The Exxon Nuclear evaluation model for BWR loss of coolant accidents consists of those analytical methods necessary to predict the fuel thermal transient which results from a loss of circulating coolant due to a postulated pipe break accident. Output from the separately-calculated system response to the accident is used as input to the model. Computer codes and other associated significant input assumptions used in the ENC evaluation model are identified and the relationship of these components as they are used in performing a BWR loss of coolant accident evaluation is described. (auth)

10323 NAERFOERLAEGGNING AV KAERNKRAFTVERK. Betaenkande av Naerfoerlaeggnings Utredningen. (Siting of Nuclear Power Plants Close to Densely Populated Areas. Report of the Investigating Committee for Siting of Nuclear Power Plants). Stockholm; Allmaenna Forlaget (1974). 328p.

Safety questions in connection with the siting of nuclear power plants in and close to major population centers have been investigated. The background of the investigation was to get enough information for planning the Swedish nuclear power program for production of electric energy and district heating. A survey is given of the function, design, and construction of the ASEA-ATOM BWR-type reactors and the Westinghouse PWR-type reactors. Environmental risks attributable to reactor accidents are discussed from the standpoint of the functions of the safety systems. (SW)

10324 SAFETY ASSESSMENT AND PROBABILITY THEORY ON NUCLEAR POWER REACTORS. Togo, Y. (Tokyo Univ.). Genshiryoku Kogyo; 20: No. 3, 24-28(Mar 1974). (In Japanese).

One important means to ensure the safety of nuclear power plants is safety assessment, by which it is confirmed that environmental and siting criteria are satisfied. In seeking the theoretical basis for this safety assessment, the theory of probability must inevitably be relied on. Reviewing the world trends in this connection, the following are described: the siting criteria based on probability theory adopted in the U. K. and Canada; probability theory utilized for the design basis accident of a plane crash on a nuclear power plant in the United States; the risk level to society considered in various countries; and problems involved in the probability treatment of the safety assessment. (JA)

10325 STUDY ON THE BLOWDOWN OF A PRESSURE VESSEL FILLED WITH SATURATED STEAM-WATER. Premoli, A.; Sandri, C. (CISE-Segrate, Milan). Energ. Nucl. (Milan); 21: No. 11, 625-637(Nov 1974).

A study dealing with the development of simple analytical models to predict thermohydraulic transients which are typical of a pressure vessel blowing through a break is presented. The work is based on experimental results obtained with a 3 m^3 vessel filled with saturated steam-water and vented through breaks simulated at different positions. The study is aimed at analyzing and discussing results and limits of some simple calculation criteria which can be applied by means of small computers only. (auth)

10326 FUEL ROD FAILURE OF MIHAMA No. 2 NUCLEAR POWER PLANT. Kume, S. (Osaka Univ.). Kagaku (Tokyo); 44: No. 3, 173-179(Mar 1974). (In Japanese).

Possible causes of fuel rod failure which occurred recently at the Mihama No. 2 plant are conjectured, based on the interim report on the accident. The outline of the interim report is given. The significance of fuel rod failure in LWR plants is emphasized. The technical aspects in the design and performance of PWR fuel cans are discussed with the concluding remark that the fuel elements are the key point in the safety and economy of nuclear power plants. Three reasons of fuel rod failure, namely collapse, swelling, and bowing, are considered. Bowing is discussed in detail because it is the most probable cause. Various references are made to other PWR fuel accidents and the corresponding reports made by Westinghouse and US AEC. Some of the fuel pins were conjectured to be stuck at spacer grids. It is strongly requested that rigorous inspection should be done on the fuel rods for presently operating PWRs; that all the results of fuel inspection of Mihama No. 1 and No. 2 plants should be made public; that the analysis of the present fuel accident should be done openly; and that the operation of the reactors should be postponed until a reasonable solution to the problem is found. (JA)

10327 SOME PROBLEMS ABOUT SAFETY OF NUCLEAR POWER STATIONS. Anzai, I. (Tokyo Univ.). Genshiryoku Kogyo; 22: No. 2, 31-36(Feb 1974). (In Japanese).

During the past two years more than ten accidents, failures, or defects in light water type nuclear power stations have been disclosed in Japan. Some of them relate to reactor safety engineering. Problems include the failure of zircaloy-clad fuel and the defects generated in reactor pressure vessels and steam generators. The emergency core cooling system also seems to be a problem because its performance reliability is not established experimentally. In the fields of workers' exposure to radiation, a practically effective control system, such as a regular examination, has not been determined for the subcontractors who are subject to exposure and/or contamination. For plant workers, the maximum permissible dose may be a problem when future increases in plant capacity are considered, since the International Commission on Radiation Protection has proposed to reduce the permissible dose per year. Environmental radiation dose and warm water discharge are also left unsolved. These problems must not be discussed separately, but treated as a whole in the Japanese policy on energy. (JA)

10328 SAFETY OF THE CLINCH RIVER PLANT. Strawbridge, L. E.; Graham, J.; Bradbury, P. (Westinghouse Electric Corp., Cheswick, PA). Nucl. Eng. Int.; 19: No. 221, 854-857 (Oct 1974).

The Clinch River Breeder Reactor (CRBR) safety is assured by a natural three level design approach: first, by providing a sound and reliable functional design based on the use of proven technology; secondly, by providing protection against anticipated and unlikely faults by a comprehensive and reliable protection system; and thirdly, by treating, as design bases, certain extremely unlikely events which are never expected to occur during the life of the plant. This third level provides additional prudent margin for assurance of the health and safety of the public. The design features adopted to implement this approach are described. (UK)

10329 ENVIRONMENTAL ASPECTS OF THE CLINCH RIVER BREEDER REACTOR PROJECT. Wright, J. H. Nucl. Eng. Int.; 19: No. 221, 851-854(Oct 1974).

The environmental effects of operating the liquid metal fast breeder reactor at Clinch River are surveyed. They are based on preliminary information which is verified by on-site surveys constantly in progress. A cost-benefit analysis which brought into account the environmental aspects was used in the design phase. The impact of construction on the local environment and environment considerations in dealing with cooling, waste treatment, and effluents are discussed. (UK)

10330 THERMAL FRAGMENTATION: A GAS RELEASE PHENOMENON. Epstein, M. (Argonne National Lab., IL). Nucl. Sci. Eng.; 55: No. 4, 462-467(Dec 1974).

On the basis of simple thermodynamic calculations and existing experimental observations, it is proposed here that the fragmentation of a molten metal in a quench liquid is caused by the violent release of dissolved gas within the molten metal. (auth)

10331 RADIOACTIVITY DECONTAMINATION IN PRIMARY COOLANT OF LIGHT WATER REACTORS. Kurosawa, T.; Mizuno, T.; Tashiro, H.; Ohtou, Y. (Central Research Inst. of Electric Power Industry, Tokyo). Denryoku Chuo Kenkyusho Gijutsu Kenkyusho Hokoku; No. 73048, 1-26(Dec 1973). (In Japanese).

A study of LWR plant experience and published papers indicated the accumulation of radioactivity in the primary coolant system. Problems concerning the decontamination of the system, e.g., recirculation pumps, main steam isolation valves, steam generators, and a reactor core bottom are discussed. The study revealed that radioactive corrosion products such as ^{60}Co, ^{58}Co and ^{54}Mn accumulated in the system. Among them ^{60}Co was the main component. The accumulation of these nuclides increases with operating time. The production of ^{60}Co was estimated. In BWR reactors, it was produced from cobalt impurities in stainless steels in feedwater heat exchangers and spacers of the core, and in inconel in spring supports of fuel rods. In PWR reactors, it was produced from the same stainless steels and inconels in steam generators and spacers. On the other hand, ^{54}Mn was produced from the 5.4% ^{54}Fe component in steels. It was supposed that the leak water from pumps and valves might contribute to the radioactive accumulation. The application of bellows valves and lanthan rings was suggested for such valves. The application of low content cobalt materials and corrosion inhibitors was suggested to reduce the production of cobalt nuclides. It was suggested that valves and pumps should be separated from the high radiation field, and the layout of the system should be improved to reduce the radiation exposure for workers. Criteria for the chemical and mechanical decontamination processes and for the processing of high level decontamination wastes are discussed. (auth)

10332 RANDOM EARTHQUAKE RESPONSE ANALYSIS OF STRUCTURES BY FOURIER SERIES EXPANSION METHOD. Application to Complex Modal Analysis. Ito, J. (Shimizu Construction Co. Ltd., Tokyo). Shimizu Kensetsu Kenkyusho-Ho; No. 21, 27-32(Oct 1973). (In Japanese).

When the earthquake response of big or complex structures is analyzed by traditional methods, the damping matrix of the whole structure is not necessarily transformable into a diagonal matrix. For such big and complex structures as nuclear power plants, modal analysis can be applied. Employing this analysis, the eigenvalue analysis of the whole system containing the damping matrix is carried out. To resolve a response equation, the Fourier series expansion method was employed, and the possibility of analyzing the earthquake response of the whole system with sufficient accuracy was investigated. This analysis method was applied to the earthquake response analysis of a nuclear power plant whose structural dimensions were simplified to eight degrees of freedom. In this plant model, the nuclear power plant is composed of a foundation, a prestressed concrete pressure vessel, a nuclear core, and a building. Each of four structures was treated as a rigid body. As for displacement vectors, two types of displacement, sway and rocking, were considered at the center of each rigid body. By giving the representative values to parameters, the eigenvalue analysis was performed, and using the results of the eigenvalue analysis, the earthquake response analysis was tried. As a result, it was recognized that the earthquake response could be analyzed with adequate precision by using the Fourier series expansion method. (JA)

10333 NUCLEAR SAFETY. Volume 15, No. 6, November–December 1974. Cottrell, W. B.; Jordan, W. H.; Sheldon, M. R. (eds.). A Technical Progress Review Published for the Technical Information Center, USAEC. Oak Ridge, TN; Oak Ridge National Lab. (1974). 139p. $0.60.

All the abnormal occurrences reported in 1973 which occurred in U. S. nuclear power reactors are reviewed and summarized. Reports of 1053 safety-related occurrences are covered to provide additional insight into those occurrences bearing on the safe operation of power reactors. A brief analysis of the composite data and a 100-word summary of each occurrence is presented in addition to keywork and permuted-title indexes on each of the four categories (Pressurized-Water Reactors, Boiling-Water Reactors, Non-Water Cooled Power Reactors, and General) into which the occurrences are grouped. Ten sections were separately abstracted and indexed for NSA. (DG)

For abstracts of individual sections see: 9301, 10250, 10334–10337, 10376, 10396, 10402, and 10408.

10334 NOVEL SITING SOLUTIONS FOR NUCLEAR POWER PLANTS. Yadigaroglu, G.; Andersen, S. O. (Univ. of California, Berkeley). Nucl. Safety; 15: No. 6, 651-664(1974).

A review of the Nov. 1973 conference on Novel Siting Solutions for Nuclear Power Plants held in San Francisco, Calif. is presented. The state of the art of major technologies for offshore and underground siting is reviewed both in terms of decoupling the licensing of reactors from site-related environmental factors and engineering, financial, and regulatory uncertainties. Problems of comprehensive site evaluation and technology assessment associated with these innovative concepts are also discussed. The conference participants agreed that major new technologies for extending siting options are available. Offshore breakwater-protected power plants seem to enjoy almost universal acceptance among architect-engineer and utility planners, but opinions were strongly divided on the safety and economics of other novel concepts. (auth)

10335 LOSS-OF-FLUID TEST INTEGRAL TEST FACILITY AND PROGRAM. Coplen, H. L.; Ybarrondo, L. J. Nucl. Safety; 15: No. 6, 676-690(1974).

The Loss-of-Fluid Test Integral Test Facility was designed to simulate, as nearly as possible, all the important effects that are anticipated to occur during a loss-of-coolant accident in a large pressurized-water-reactor-type nuclear steam-supply system. Integral, as used here, defines an experiment combining the nuclear, thermal, hydraulic, and structural processes occurring during a loss-of-coolant accident as opposed to the single- and dual-effect, nonnuclear, small-scale, thermohydraulic experiments conducted to date. A minimum of 19 loss-of-coolant experiments is planned in the Loss-of-Fluid Test with various simulated line-break locations and sizes, including some initial isothermal tests using a core simulator rather than the actual fuel assemblies. (auth)

10336 RECENT OCCURRENCES AT NUCLEAR REACTORS AND THEIR CAUSES. Casto, W. R. (comp.). Nucl. Safety; 15: No. 6, 742-750(1974).

Information on reactor occurrences from reports abstracted for the Nuclear Safety Information Center at Oak Ridge National Laboratory in July and August 1974 is presented. A brief description of each incident is included in the tabulated data, along with the reactor, facility, or institution at which the incident occurred. (auth)

10337 SELECTED SAFETY-RELATED OCCURRENCES REPORTED IN JULY AND AUGUST 1974. Casto, W. R. (comp.). Nucl. Safety; 15: No. 6, 751-756(1974).

Three reactor occurrences are reviewed because of their uniqueness and/or general interest to reactor operations. At Monticello, two explosions in the off-gas system within 3 weeks led to a noteworthy decision to eliminate rupture disks in the affected off-gas system. At the General Electric Test Reactor, the control rods containing boron experienced sufficient radiation damage for the effects to be visible. A sudden loss of power at the two-unit Turkey Point plant was handled with very little difficulty. (auth)

10338 A THERMAL STRESS MECHANISM FOR THE FRAGMENTATION OF MOLTEN UO_2 UPON CONTACT WITH SODIUM COOLANT. Cronenberg, A. W.; Chawla, T. C.; Fauske, H. K. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 30: No. 3, 434-443(1974).

An important aspect of fuel-coolant interaction problems relative to various hypothetical LMFBR accidents is the fragmentation of molten oxide fuel on contact with sodium coolant. In order to properly analyze the kinetics of such an event, an understanding of the breakup process and an estimate of the size and dispersion of such fragmented fuel must be known. A thermal stress initiated mechanism for fragmentation is presented using elastic stress theory for the cases of both temperature-dependent and independent mechanical properties. Included is a study of the effect of the choice of surface heat transfer boundary condition and the compressibility of the unsolidified inner core. Results of parametric calculations indicate that the thermal stresses induced in the thin outer shell and the pressurization of the inner molten core are potentially responsible for the fragmentation. For UO_2 in Na the calculated stresses are extremely high, while for aluminum in water they are much smaller and a strong function of the surface heat transfer boundary condition. Qualitatively, these results compare favorably with small scale dropping experiments, that is, molten UO_2 quenched in Na undergoes fragmentation while aluminum in water usually results in little breakup. The experimentally observed increase in breakup with decreasing coolant temperature is also in qualitative agreement with the thermal stress-induced mode of fragmentation. (auth)

10339 STRUCTURAL SAFETY AND RELIABILITY OF PRIMARY SYSTEM PRESSURE BOUNDARIES FOR WATER COOLED POWER REACTORS. Kellermann, O. (Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (F. R. Germany)); Costes, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)); Hazelton, W. S. (USAEC Directorate of Licensing, Washington, D. C.); Keller, W. (Kraftwerk Union A. G., Erlangen (F. R. Germany)); O'Neil, R. (UKAEA Safety and Reliability Directorate, Culcheth); Seipel, H. G. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)); Smidt, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung); Vinck, W. (Commission of the European Communities, Brussels (Belgium)); Witt, F. J. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Eng. Des.; 28: No. 2, 218-238(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

A discussion is given of the reliability of the primary coolant circuit in water cooled power reactors. The merits of pressure vessels constructed from steel, prestressed concrete and cast iron are presented in terms of their relative safety. Standards of design and construction of pressure vessels are of high quality. (NL)

10340 REPORT ON THE INTEGRITY OF REACTOR VESSELS FOR LIGHT WATER POWER REACTORS. Nucl. Eng. Des.; 28: No. 2, 147-195(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

A report is made on reactor vessels for PWR and BWR type reactors. Current construction and design practices are described, and possible failure mechanisms, e.g., crack growth, fatigue, corrosion, are considered. The available pressure vessel failure statistics and failure probabilities are given. It is concluded that current methods give a high degree of assurance against nuclear vessel failure, but further recommendations are made for (a) selection of materials (b) design of vessels (c) nondestructive testing (d) inservice inspection and surveillance (e) operation. (NL)

Reactor Theory and Calculation

Refer also to abstracts 10244 and 10258.

10341 (JAERI-M-5658) ARCADIA-I: ON-LINE SYSTEM FOR CROSS SECTION ADJUSTMENT BY GRAPHIC DISPLAY. Nakamura, Y.; Onuma, Y.; Kuroi, H. (Japan Atomic Energy Research Inst., Tokyo). Apr 1974. 47p. (In Japanese). NTIS (U. S. Sales Only).

The on-line graphics system ARCADIA-I, which adjusts the cross section library AGLI for fast reactor analysis, has been developed for the F230-35 ROS system. In ARCADIA-I, the CRT, lightpen, and alphanumerical keyboard of the graphic display system can be used effectively. Appropriate adjustment of the AGLI library can be made easily and visually. The adjusted library can also be used as input to the computer codes for reactor physics analysis in the F230-60 system. (auth)

10342 (ORNL-TM-4732) THEORY OF CORRELATION MEASUREMENT IN TIME AND FREQUENCY DOMAINS WITH ^{252}Cf. Mihalczo, J. T.; Pare, V. K. (Oak Ridge National Lab., Tenn. (USA)). Nov 1974. Contract W-7405-eng-26. 30p. Dep. NTIS $4.00.

The theory of cross-correlation measurements between the pulses from an ionization counter containing a ^{252}Cf neutron source, which furnished the initiators of fission chains in a neutron-multiplying assembly, and the pulses from a detector observing the particles from the fission chains is reviewed. The expression for the detector response in this type of measurement is first presented in the time domain. Then the cross-power spectral densities in the frequency domain measurements are developed. The theory of the usual two-detector noise measurement is reformulated to incorporate a modified Diven factor that includes the effects of neutrons from external sources such as spontaneous fission of the californium and the reactor fuel. Finally, the equivalence between both the time and frequency domain expressions is demonstrated. A new method of reactivity determination is proposed which avoids some of the difficulties of the present methods, such as dependence on detection efficiency and inherent source strength, and the requirement for a calibration near delayed criticality. (auth)

10343 (PNCT-831-74-01) TOKAI WORKS SEMI-ANNUAL PROGRESS REPORT, JULY–DECEMBER 1973. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). May 1974. 65p. Dep. NTIS (U. S. Sales Only) $6.25.

Progress is reported in the following areas: (1) criticality studies of PuO_2-UO_2 water-moderated lattices, (2) test fabrication of JOYO fuel, (3) plutonium-contaminated liquid waste management and treatment, (4) ATR fuel pin thermal studies, (5) UO_2 stress analysis and cladding compatibility studies, and (6) metallurgical analysis of zirconium alloys. (DG)

10344 (TUBIK-36) FULLY DEVELOPED, LONGITUDINAL, LAMINAR FLOW ANALYSIS FOR FINITE, HEXAGONAL ROD BUNDLES. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Kerntechnik). 1974. 206p. (In German). Dep. NTIS (U. S. Sales Only) $13.50.

Thesis.

An analytical method for calculating the fully developed, longitudinal, laminar flow in finite hexagonal rod bundles of arbitrary size is presented. Results are the two-dimensional velocity field, local and average shear stresses at the rod and cassette surfaces, average velocity, pressure drop, and friction factor. The influence of the parameters pitch, wall distance, porosity, and number of rods is analyzed. (auth)

10345 KSENONOVYE PEREKHODNYE PROTSESSY V YADERNYKH REAKTORAKH. (Xenon Transient Processes in Nuclear Reactors). Rudik, A. P. Moscow; Atomizdat (1974). 72p.

The theory of xenon transient processes in nuclear reactors is presented in available and simple form. A large amount of attention is devoted to an elementary presentation of the theory of optimizing the time of the transient process and the energy evolved in the transient process. Consideration is also given to the effect of spacial inhomogeneities on the characteristics of transient xenon processes. (SJR)

10346 INVESTIGATION OF THE SPACE- AND ENERGY-DEPENDENT COHERENCE FUNCTION IN ZERO-POWER COUPLED-CORE REACTORS. Ebert, D. D. (Georgia Inst. of Tech., Atlanta); Clement, J. D.; Stacey, W. M. Jr. Nucl. Sci. Eng.; 55: No. 4, 368-379(Dec 1974).

An investigation of the kinetic characteristics of coupled-core reactors using noise analysis techniques is undertaken. It is shown that time- and frequency-domain methods of noise analysis are closely related and their particular space-dependent forms arise from the manner in which the impulse response or transfer function is approximated. Using an analytical and two modal expansion approximations of the neutron noise, the significance of the coherence function frequency characteristics under varying hypothetical detector placements and core conditions is interpreted. Coherence function computational results using a one-dimensional, two neutron-energy group diffusion theory model provide good agreement with measurements. (auth)

10347 NUCLEAR PHYSICS OF FAST REACTORS. Beynon, T. D. (Univ. of Birmingham, Eng.). J. Phys., A (London); 37: No. 8, 951-1034(1974).

The nuclear physics aspects of fast reactor research and development are reviewed with particular emphasis on the evolving experimental and theoretical techniques for predicting and understanding the performance of the liquid metal fast breeder reactor. A general account of this oxide-fueled, liquid-sodium-cooled system is given. The physical aspects of the uranium-plutonium breeding cycle are discussed. Recent measurements of the capture-to-fission ratio are given and methods of defining the breeding ratio of a system are examined. Recently used techniques for determining the prompt neutron fission yield and the prompt neutron energy spectrum are mentioned, and the available techniques for measuring fast neutron cross sections are reviewed in detail. Two aspects of reactor safety are dealt with: the effect of delayed neutrons from fast fission on the temporal behaviour of a fast reactor; and the role of the nuclear Doppler effect should the reactor undergo a power excursion under accident conditions. Recent observations of both the discrete nature of delayed neutron energy spectra and the energy dependence of delayed neutron yields are examined along with recent evaluations of delayed neutron data. Phenomenological nuclear modelling is discussed with reference to coupled channel optical and fluctuating compound nucleus models. A brief look at subthreshold fission and the establishment of its relevance to fast reactor physics is followed by a discussion of the nuclear Doppler effect. (auth)

10348 INTERPRETATION OF COHERENCE FUNCTION MEASUREMENTS IN ZERO-POWER COUPLED-CORE REACTORS. Ebert, D. D. (Georgia Inst. of Tech., Atlanta); Clement, J. D.; Stacey, W. M. Jr. Nucl. Sci. Eng.; 55: No. 4, 380-386(Dec 1974).

New techniques for inferring several reactor kinetic parameters from frequency-domain noise analysis measurements in coupled-core reactors are developed and utilized. These parameters are the eigenvalue separation, delayed-neutron fraction, and, independently, the prompt-neutron lifetime. Reactor characteristics and detector placement criteria necessary for obtaining the parameters are discussed. Comparison with other time-domain noise techniques is undertaken and the merits and shortcomings of each are reviewed. (auth)

10349 NONSTATIONARY TRANSPORT OF NEUTRONS IN A BLOCK OF MODERATOR CONTAINING A LARGE CAVITY. Ilieva, K. D.; Kazarnovskii, M. V. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1029(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 346(Nov 1973).

Transport of neutrons from a pulsed source in a spherical block of moderator with a large spherical cavity is considered. The neutron flux emerging into the cavity is calculated in the isotropic approximation, and an expression for the total flux is given which takes into account the nonexponential attenuation effects of the accumulation of slow neutrons in the cavity. (DG)

10350 ASYMPTOTIC NEUTRON FLUX FROM A PULSED SOURCE IN A MODERATOR WITH AN INFINITE PLANE SLOT. Ilieva, K. D.; Kazarnovskii, M. V. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1030(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 347(Nov 1973).

Transport of neutrons in a system of two homogeneous moderator slabs separated by a wide plane slot containing an infinite, uniformly distributed pulsed source is considered. The neutron flux is evaluated in the isotropic, one-velocity approximation. Results indicate that direct numerical calculations can be performed for specific cases in the first approximation in the one-velocity model under the assumption of isotropy of the neutron flux emerging from the moderator. (DG)

10351 PROPAGATION OF NEUTRONS IN AN ANISOTROPIC MEDIUM. Dolgov, A. S. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1031(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 347(Nov 1973). This is a summary of paper No. 703/7282 with full copy held at TIC.

In certain cases the anisotropy of a medium of microscopic or macroscopic character leads to the dependence of the mean free path on the direction of motion of a particle, which can be taken into account by introducing anisotropic cross sections for the processes. An analytical solution of the problem of the transport of isotropically diffusing particles with orientational inhomogeneity of the properties of the medium is considered. The method used is related to the method of Fourier transforms and the method of elementary solutions. A solution of the problem is found for arbitrary boundary conditions and arbitrary geometry. Solutions in the corresponding limiting cases reduce to known solutions for a homogeneous medium. The application of the methods of spherical harmonics and discrete ordinates to problems of transport in an anisotropic medium is discussed. A general form of the equations of the P_n-approximations of the method of spherical harmonics is established, and calculation relations of the method of discrete ordinates are found. It is explained that unlike the method of spherical harmonics, the use of the method of discrete ordinates does not lead to a significant increase in volume of calculations in comparison with the corresponding case for an isotropic medium. (auth)

10352 STABILITY CONDITIONS FOR THE STEADY STATE OF CONNECTED REACTORS. Babkin, N. A.; Goryachenko, V. D. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1047-1049 (Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 359-360(Nov 1973).

Sufficient conditions are determined for the stability "in the small" of a group of different reactors of arbitrary number for general assumptions concerning the form of the neutron interactions and the internal feedbacks within each reactor. (auth)

10353 SINGLE PHASE TRANSPORT WITHIN BARE ROD ARRAYS AT LAMINAR, TRANSITION AND TURBULENT FLOW CONDITIONS. Ramm, H.; Johannsen, K. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Kerntechnik); Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Nucl. Eng. Des.; 30: No. 2, 186-204 (1974).

A theoretical analysis has been performed to study molecular and turbulent transport phenomena between subchannels of infinite bare rod arrays at laminar, transition and turbulent flow conditions. For this investigation, the theoretical approach of Ramm and Johannsen for predicting turbulent momentum and heat transfer in rod bundles has been extended to evaluate three-dimensional temperature fields. Results are presented enabling the prediction of the onset and growth of laminarization in typical subchannels of square and triangular rod arrays. These results are further applied to interpret the characteristic effects of variations in Reynolds number, Prandtl number or geometric spacing on integral exchange parameters as the thermal mixing flow rate and mixing length scale. These results are of particular significance relative to the explanation of recent data from tracer-type mixing experiments and also exhibit the importance of secondary flow effects on turbulent intersubchannel energy transport. In view of these findings, the physical relevance of current correlations derived from integral-type experiments to numerically predict exchange coefficients for use in lumped parameter subchannel analysis codes is discussed. (auth)

10354 DYNAMICS OF A ROD-SHELL SYSTEM CONVEYING FLUID. Chen, S. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 30: No. 2, 223-233(1974).

The dynamics of a rod-shell system simulating nuclear reactor fuel rod bundles subjected to a parallel flow is studied analytically. Frequency spectra are presented and the effects of the flow velocity are discussed. It is shown that the natural frequency and critical flow velocity of the coupled rod-fluid-shell system are smaller than those of an isolated rod subjected to an axial flow. (auth)

10355 ACCURACY OF EXPERIMENTAL METHODS USED IN INVESTIGATIONS OF REACTOR CHARACTERISTICS ON CRITICAL ASSEMBLIES WITH SLIGHTLY ENRICHED UO_2 FUEL AND LIGHT WATER MODERATOR. Dabrowski, C. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 19: No. 9, 791-802(1974). (In Russian).

The development of the experimental methods and of the comparison of the experimental results with the theoretical description for light water lattices with slightly enriched UO_2 fuel has been presented. On the basis of the neutron balance for one chosen 3% enriched UO_2:H_2O lattice, the influence of the accuracy of reactor parameters on k_{eff} has been evaluated. The data on the accuracies of these parameters attained in advanced laboratories have been compiled. On these bases the recommended accuracy values for the reactor parameters have been derived. (auth)

10356 EXTENSION OF CASE'S METHOD TO THE TWO-REGION CRITICAL CYLINDER AND ITS APPLICATION AS AN ANALYTIC STANDARD. Westfall, R. M. Charlottesville, VA; Univ. of Virginia (1974). 133p. University Microfilms Order No. 74-23,258.

Thesis (Ph. D.).

The normal mode expansion technique is applied to the transformed monoenergetic integral transport equation to develop a solution for the rotationally invariant and axially infinite, critical, two-region cylinder with a finite outer reflector boundary. The model assumes isotropic scattering and identical neutron mean free paths in the core and reflector regions. The solution in terms of singular integral equations is obtained by applying a completeness theorem found for the singular eigenfunctions. Numerical results for a variety of core and reflector multiplying properties and reflector thicknesses are presented and compared with the results of other methods. The completeness inherent in this solution and the high precision in the numerical calculations provide results which may be used as analytic standards for this problem. An example of this type of application is given in a study of approximations inherent in the neutronic design analysis of a small, fast-neutron-spectrum reactor concept proposed as a space power source. Using the highly precise critical dimensions for the case which most closely approximates this reactor, investigations were made of the reactivity effects of angular quadrature type and order of two-dimensional geometrical models used in the discrete-ordinates transport analysis of this concept. (Diss. Abstr. Int., B)

10357 NEUTRON MODERATION IN FAST REACTORS IN THE PRESENCE OF WIDE SCATTERING RESONANCES: ANALYSIS OF METHODS. Palmiotti, G.; Salvatores, M. (Centro di Studi Nucleari Casaccia, Rome). Nucl. Sci. Eng.; 55: No. 4, 476-480 (Dec 1974).

An analysis of methods is presented for the treatment of wide scattering resonances in light and intermediate elements of interest for fast reactors. An approximate method, based on the continuous slowing-down theory, is shown to be in good agreement with the most refined methods; this method is suggested for further use in both the self-shielding factors and the intermediate-energy-group strategies for cross-section generation currently under development. (auth)

10358 SYSTEMATIC ERRORS IN THE DISCRETE TIME-INTERVAL TRANSMISSION METHOD FOR THE ESTIMATION OF VOID STATISTICS IN BOILING CHANNELS. Barrett, P. R. (New South Wales Univ., Kensington (Australia). School of Nuclear Engineering). Nucl. Eng. Des.; 30: No. 3, 316-327(1974).

The single long-time method of observation for transmission experiments across boiling channels produces an indecisive value for the mean of the void fraction $\langle\alpha\rangle$, and can be correctly interpreted for conditions of low noise level only. The finite interval method is employed in an attempt to determine $\langle\alpha\rangle$ with much greater accuracy; however, the problem arises that, since the value of $\alpha(t)$ over the nth time interval $t_n \leq t \leq t_n + \delta t$ is assumed approximately constant at α_n, this finite period δt, should be as small as possible whereas reducing δt increases the statistical counting errors. The systematic error introduced by the finiteness of δt is examined and a method is suggested for planning the experiment in such a manner as to minimize statistical counting errors. This method is based on achieving those conditions that ensure the expected variance of an experimentally estimated form of $\langle\alpha\rangle$ is so small that the estimated form of $\langle\alpha\rangle$ may be confidently assumed to be very close to its expected mean value. (auth)

Reactor Components and Accessories

Refer also to abstract 9259.

10359 (AECL-4827) ON THE USE OF MgO AS INSULATION FOR COAXIAL SIGNAL CABLES IN A REACTOR ENVIRONMENT. Lynch, G. F.; Shields, R. B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jun 1974. 41p. Dep. NTIS (U. S. Sales Only) $5.25. AECL $1.00.

The electrical properties of mineral-insulated coaxial cable depend on the temperature and radiation environment to which they are subject. The ionic and γ-ray induced conductivities of polycrystalline MgO, as used in reactor instrumentation cable, have been studied in the temperature range 300-600°K. Outside the radiation environment the conductivity is due to the migration of positive-ion vacancies with an activation energy of 1.50 eV. The magnitude of the conductivity is much larger than would be expected from the normal vacancy concentration and this is attributed to extra magnesium vacancies acting as charge compensators for trivalent transition-metal ion impurities. In the γ-ray radiation field of a ^{60}Co source the observed photoconductivity is explained by a trapping model, with levels at 0.04, 0.55 and 1.35 eV below the conduction band. The γ-ray induced conductivity is consistent with a linear dependence on the radiation dose rate up to 3.0×10^5 rd/h (H_2O). (23 references) (auth)

10360 (CEA-CONF-2671) NONDESTRUCTIVE TESTING, FRACTURE MECHANICS, IN CONNECTION WITH PRE- AND IN-SERVICE INSPECTIONS OF NUCLEAR REACTOR PRIMARY CIRCUITS. Prot, A.; Saglio, R.; Petrequin, P.; Dore, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). Dec 1973. 12p. (CONF-740676-1). Dep. NTIS (U. S. Sales Only) $4.00.

From conference on in-service inspection of pressure vessels; London, UK (4 Jun 1974).

It is shown that present NDT techniques, used in fabrication, pre-service and in-service inspection of nuclear reactor primary circuits fail to give data accurate enough to allow interpretation by means of fracture mechanics considerations. A solution to overcome this problem is also given. (auth)

10361 (RDT-E-15-2NBT(11-74)) CLASS I NUCLEAR COMPONENTS (SUPPLEMENT TO ASME BOILER AND PRESSURE VESSEL CODE, SECTION III, SUBSECTIONS NA AND NB). (USAEC Division of Reactor Research and Development, Washington, D. C.). Nov 1974. 36p. RSO.

A standard is presented which supplements the rules for construction of nuclear components covered by the ASME Boiler and Pressure Vessel Code, Section III, Subsections NA and NB. (JWR)

10362 (TNO-1) DEPT. OPERATION OF 50 MW TEST LOOP. Report Concerning Weeks 1 to 5, 1974. (Nijverheidsorganisatie TNO, Aperldoorn-Zuid (Netherlands). Centraal Technisch Instituut TNO). 1974. Translated from Dutch. 27p. Dep. NTIS $4.00.

During this period the sodium system and the steam/feedwater system were connected up thermally for the first time with the aid of evaporator E 204. After the temperature and pressure of the new subsystem had been set in accordance with the program agreed with Stoomwezen and the Stoomwezen safeguards calibrated, other power steps were carried out. The maximum output was 42 MW (February 1). After repairs to various sodium system valves, the first half of the period was devoted to setting and calibrating various measuring and actuating devices. On the sodium side a hydrogen injection test was performed on January 18 in order to test the QRAEs. (auth)

10363 (TNO-2) DEPT. OPERATION OF 50 MW TEST LOOP. Report Concerning Weeks 6 to 9, 1974. (Nijverheidsorganisatie TNO, Aperldoorn-Zuid (Netherlands). Centraal Technisch Instituut TNO). [nd]. 18p. Dep. NTIS $4.00.

In this period the trials of steam generator E 204 were continued and the qualification tests terminated. During this time the steam generator was run on one occasion for 24 h at a power output of 50 MW. Measurements are being performed at different part-loads, both saturated and superheated, and maximum and minimum loads determined. By reducing the power to the minimum to be transferred, the trials on E 204 were temporarily completed, after which a start was made on getting steam generators E 201 and E 202 ready for operation again. (auth)

10364 STRUCTURE OF NEW TYPE REACTOR PRIMARY CONTAINMENT VESSEL. Wada, T. (Hitachi Ltd., Ibaraki, Japan). Hitachi Hyoron; 56: No. 8, 713-718(Aug 1974). (In Japanese).

A light bulb-torus type (MARK-I type) containment vessel, in which a torus-shaped suppression chamber is provided around the light bulb-shaped drywell, has been used mainly, but recently, an over-under type (MARK-II type) containmant vessel which has a frustum drywell over a cylindrical suppression chamber has come to be used increasingly because of its advantages with respect to safety, maintenance, and the control of the reactor. The MARK-II is compared with the MARK-I in such points as applicable codes, structure, materials, fabrication, and inspection and a description of the characteristics of the MARK-II is given. (auth)

10365 STEELS FOR NUCLEAR APPLICATIONS. Roesler, U.; Cerjak, H. Radex Rundsch.; No. 3-4, 220-229(Sep 1972). (In German).

The use of austenitic Cr–Ni stainless steel in pressurized water reactors for nuclear power stations is discussed in detail. Steam generator tubes which are in contact with primary and secondary coolants are made of high-Ni alloys (Inconel 600 and Incoloy 800). (Metals Abstr)

10366 EFFECTIVENESS OF THE RUSSIAN ROULETTE-SPLITTING TECHNIQUE IN REACTOR SHIELDING ANALYSIS. El-Sheikh, K. A. R. Ann Arbor, MI; Univ. of Michigan (1974). 149p. University Microfilms Order No. 74-25,195.

Thesis (Ph. D.).

The Russian Roulette-Splitting technique is investigated with particular emphasis on exploring its potential for use in a computerized shielding design procedure. A generalized probability model for the technique is developed and analyzed. The problem of estimating the optimum biasing function, which is common among all biasing techniques, has also been investigated. The theoretical basis for a computerized logic to estimate the optimum biasing function without waste of the computation time has been developed and applied for plane homogeneous shields. (Diss. Abstr. Int., B)

10367 NUCLEAR ENERGY AND WELDING. Fujimura, T. (Japan Atomic Energy Research Inst., Tokai). Yosetsu Gijustsu; 22: No. 1, 25-28(Jan 1974). (In Japanese).

In order to maintain the standard of living of mankind by making the demand and supply of energy compatible with the prevention of environmental damage, it is necessary to curtail energy consumption and to develop effective energy sources. By curtailing energy consumption, environmental damage can be decreased, and the rate of operation of plants decreases so that accidents are reduced. As to the development of effective energy sources, steady technical improvements with a long-range view are necessary; that is, it is important to improve thermal efficiency and to develop energy conversion techniques using nuclear fission and nuclear fusion. Welding techniques have a great influence on the development of the atomic energy industry. Many problems are left unsettled on the welding of nuclear reactor components. For example, the welding of end plugs for sealing fuel cans still has some weakness. Even though A533B-C1.2 of C1.3 steel is preferred to lighten large reactor pressure vessels, it is not yet confirmed that the strength of a welded part is the same as that of the steel proper. Welding techniques must be effective to confine radioactive materials within reactor pressure vessels. (JA)

10368 THEORETICAL EFFECT OF A SOFT METAL INTERLAYER UPON STRAINS PRODUCED IN FUEL CLADDING BY THE EXPANSION OF CRACKED CYLINDRICAL FUEL PELLETS. Gittus, J. H. (UKAEA Reactor Group, Springfields). Nucl. Eng. Des.; 30: No. 2, 293-295(1974).

The strain distributions produced in collapsed cladding by the expansion of cracked pellets during a power increase have been calculated analytically to establish the effect of a soft metal interlayer. As the radial cracks in the pellet open, the tendency for the cladding to stretch preferentially over them is reduced by frictional sliding at the pellet/clad interface. The frictional forces opposing sliding are reduced by the interlayer, whilst the ability of the cladding to resist the friction forces without being locally deformed depends on its work-hardening coefficient. The efficacy of the interlayer is greatest for interlayers which require the least strain to bed them in. (auth)

10369 NONLINEAR DYNAMIC RESPONSE OF CRACKED REINFORCED CONCRETE NUCLEAR CONTAINMENT VESSELS. Laible, J. P. (Vermont Univ., Burlington (USA)); Gergely, P. (Cornell Univ., Ithaca, N. Y. (USA)). Nucl. Eng. Des.; 30: No. 2, 296-304(1974).

In the design of reinforced concrete nuclear vessels horizontal cracks are assumed to exist as a result of pressurization. Seismic shear forces must be transmitted across these cracks. The nonlinear dynamic response of cracked vessels is studied. The force-displacement relationship across the cracks are taken from the experimental investigation that included the shear transferred by the concrete but not by dowel action of the vertical steel. The stiffness is highly nonlinear, hysteretic, and degrading. A modal analysis technqiue, based on an eigenvalue reanalysis procedure, is developed and it is compared with a direct numerical integration solution. Only typical response values are given for particular values of the variables and for one particular earthquake input. (auth)

10370 THE AXISYMMETRIC FREE VIBRATION AND TRANSIENT RESPONSE OF A CLAMPED CYLINDRICAL SHELL OF LINEAR VARYING THICKNESS. Fisher, H. D. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Nucl. Eng. Des.; 30: No. 2, 278-285(1974).

A variety of structural design problems in nuclear engineering require a knowledge of the dynamic response of variable thickness shells. Specific examples are natural draft cooling towers subjected to wind loading, and the core support barrel of a pressurized water reactor during a loss of coolant accident, where the maximum radial deflection due to hydrodynamic loading is a critical design parameter. These applications indicate the relevance of the investigations on the free vibration and transient response of a circular cylindrical shell of linear varying thickness. Mode shapes and frequencies, calculated in the free vibration analysis, are used in a modal solution for the transverse displacement and bending stress of the forced vibration problem. Numerical results are presented for two clamped cylinders subjected to a triangular pressure-time history. Application of the analysis to constant thickness cylinders which are linearly thickened near a clamped support is discussed. (auth)

10371 ANALYSIS OF PCRV LINERS BY THE INITIAL STRESS METHOD. Guerbuez, O.; Lee, T. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.); Johnson, K. L. (General Dynamics Corp., San Diego, Calif. (USA). General Atomic Div.). Nucl. Eng. Des.; 30: No. 2, 269-277(1974).

In the design of prestressed concrete reactor vessel (PCRV) liners with closely spaced anchors, analyses are conducted to determine forces on and displacements in the liner components under concrete-imposed strains. A new method of one-dimensional liner stress analysis is presented. The method uses a stiffness approach in which the final set of simultaneous equations are the equilibrium equations in terms of unknown modal displacements. The solution of these nonlinear simultaneous equations is accomplished using the "initial stress method." A parametric study has been conducted to investigate the effects of main liner design variables. Results of this study are presented and discussed. (auth)

10372 CONNECTING PIECE FOR PRESSURE VESSEL COVER OF NUCLEAR REACTORS. Bazant, E.; Cerjak, H.; Scholz, M. (to Siemens Aktiengesellschaft). US Patent 3,834,740. 10 Sep 1974. Priority date 22 Nov 1969, GE. 4p.

A description is given of a connecting piece which extends into a port formed in a nuclear reactor pressure vessel cover having a plated layer on the inner surface. The compound piece is made up of a compound tube provided with an austenitic steel inner liner tube at least in the vicinity of the port, the connecting tube extending within the port substantially to the inner surface of the pressure vessel cover and being secured to the plated layer by welding. (Official Gazette)

10373 MEANS FOR RAPIDLY EXPOSING THE CORE OF A NUCLEAR REACTOR FOR REFUELING. Frisch, E.; Andrews, H. N. (to Westinghouse Electric Corp.). US Patent 3,836,429. 17 Sep 1974. Filed date 8 Jul 1970. 6p.

A description is given of an upper structure of a nuclear reactor consisting of the control rod mechanisms, the pressure vessel closure head, the upper internals package, and other associated structure, connected to form an integral unit which may be removed from the reactor vessel in a single lift to expose the fuel assemblies of the reactor core to the open end of the reactor vessel. The closure head is hung from the control rod drive missile shield and the upper internals package is hung from the closure head. (Official Gazette)

10374 FLUID-COOLED NUCLEAR REACTOR. Cook, R. K.; Burylo, P. S. (to British Nuclear Design and Construction Ltd., and English Electric Co. Ltd.). US Patent 3,834,987. 10 Sep 1974. Priority date 23 Dec 1969, United Kingdom of Great Britain and Northern Ireland. 4p.

To achieve a rapid reduction in heat output from a fluid-cooled nuclear reactor with a direct-cycle gas turbine, provision is made for permitting a proportion of the cool coolant fluid fed to the upstream side of the reactor core to by-pass the core and mix with, and thus reduce the temperature of, heated coolant emergent from the downstream side of the core. The accessibility of fluid control equipment is thereby improved, and, where the gas turbine is disposed in a pod defined in the wall thickness of the reactor pressure vessel, interference with the pressure vessel stressing system is avoided. (Official Gazette)

10375 CABLE SUPPORT STRUCTURE FOR ENABLING A NUCLEAR REACTOR TO BE REFUELED RAPIDLY. Frisch, E.; Andrews, H. N. (to Westinghouse Electric Corp.). US Patent 3,836,430. 17 Sep 1974. Filed date 8 Jul 1970. 6p.

A reactor enclosure is described in which the cables containing the electrical wiring for the control rod mechanisms and the reactor instrumentation are brought by the shortest path to cable support racks affixed to the enclosure, which also surrounds the control mechanisms. The cables are supported on a series of such support racks until they terminate in receptacles mounted on the floor of a platform attached to the enclosure on the side facing the refueling storage area for the mechanisms, vessel head, and internals. An elongated frame-like cable tray is attached to the platform by a hinged joint while the other end is supported on flanged guide rollers. The cables are looped onto the cable tray at its hinged end and are supported in tiers by separator plates and anchor clamps. At the other end of the tray, the cables are hung in large loops and are connected to plugs in the floor of the instrument room. The cables accordingly need not be disconnected from the mechanisms when refueling. (Official Gazette)

10376 ELEMENTAL IODINE AND METHYL IODIDE ADSORPTION ON ACTIVATED CHARCOAL AT LOW CONCENTRATIONS. Bellamy, R. R. (Atomic Energy Commission, Bethesda, MD). Nucl. Safety; 15: No. 6, 711-723(1974).

The capability of activated charcoal to adsorb elemental iodine and methyl iodide at low concentrations has been experimentally evaluated to observe the effect of the variation of certain operating parameters within specified limits. The operating parameters include inlet concentration, superficial velocity, relative humidity, type of charcoal and impregnant, charcoal mesh size, duration of test, and bed depth. The data obtained in an intensive study of these parameters have been correlated assuming a two-step adsorption mechanism for radioiodine on activated charcoal. The correlation is presented to aid the nuclear industry in designing charcoal-adsorber systems for radioiodine retention. (auth)

10377 THERMAL STRESSES IN HETEROGENEOUS THICK ISOTROPIC SHELLS. Venkataramana, J. (Structural Engineering Division, Vikram Sarabhai Space Centre, Trivandrum 695022, India). Nucl. Eng. Des.; 30: No. 3, 369-378(1974).

The application of a thick shell theory in the design of nuclear pressure vessels is given. A derivation for thick shells of revolution with the inclusion effects of transverse shear stress and normal stress, in which the Young's modulus is considered dependent on temperature, is presented. The set of equations so obtained are solved by a numerical integration method. The example of a spherical shell is solved and the results compared with the case in which the Young's modulus is assumed to be constant. It is shown that under large temperature gradients through the thickness, the change in deflections and stresses can be significant, if the present derivation is used. (auth)

Reactor Fuels

Refer also to abstract 8202, 8333–8335, and 9273.

10378 (CONF-740947-4) THERMAL DENSIFICATION OF MIXED-OXIDE FUEL. Voglewede, J. C. (Argonne National Lab., Ill. (USA)). [nd]. 14p. Dep. NTIS $4.00.

From American Ceramic Society meeting; Williamsburg, Virginia, USA (29 Sep 1974).

The out-of-pile stress-assisted densification of mixed-oxide fuel materials is examined. A constitutive equation for final-stage densification of mixed-oxide fuels is presented which is applicable to a wide range of temperature, stress, and density. (JWR)

10379 (CONF-741030-3) CHEMICAL MODELING OF URANIUM, PLUTONIUM, AND OXYGEN REDISTRIBUTION IN OXIDE FUELS BY VAPOR TRANSPORT AND DIFFUSION. Blackburn, P. E.; Johnson, C. E. (Argonne National Lab., Ill. (USA)). 1974. 22p. (SM-190/50). Dep. NTIS $4.25.

From symposium on thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974).

A computer model has been written to determine redistribution of oxygen, uranium, and plutonium in irradiated fuels as a function of time and at steady state. Oxygen movement is controlled by ionic diffusion where the driving force is the product of activity-independent coefficient and oxygen activity as represented by the atomic oxygen pressure. Coefficients have been derived from available data for lattice diffusion of ions through vacancies and interstitial ion diffusion. For diffusion through vacancies, a distinction is made between low O/M fuel (near the metal-rich boundary) in which lattice diffusion depends on oxygen activity and fuel near stoichiometric composition, in which diffusion is limited by low vacancy concentrations. Steady-state oxygen distribution is achieved when, over the O/M range of interest, no gradient exists in the product of the appropriate diffusion coefficient and the atomic oxygen pressure. Solid-state oxygen-ion diffusion is much more rapid in the fuel than gas-phase oxygen transport. Redistribution of uranium and plutonium occurs by vapor-phase transport through the porous fuel. As the gaseous actinide species diffuse from the hot side to the cool side of the pores, noncongruent vaporization and condensation within the pores result in changes in the uranium and plutonium distribution. When the central portion of the fuel, which is hot enough for vaporization of actinides, densifies (with concurrent enlargement of the central void), migration of the gaseous actinide species virtually ceases. The redistribution model is found to predict distributions of all three elements in reasonable agreement with observations of irradiated fuels. (auth)

10380 (EIR-265) POST IRRADIATION EXAMINATION OF FOUR (UPu)C SPHERE-PAC FUEL PINS IRRADIATED IN THE DIDO REACTOR AT HARWELL. Smith, L.; Peddicord, K. L.; Buetzer, P.; Rickenbacher, P.; Buergisser, B. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Nov 1974. 99p. Dep. NTIS (U. S. Sales Only) $8.00.

The results of the Post Irradiation Examination of four fuel pins irradiated in the DIDO reactor are reported. The fuel for all the pins was E.I.R. produced Uranium-Plutonium Monocarbide in the form of spheres vibrationally packed into AISI 316 stainless steel pins to a smeared density of ~75% theoretical. Mean burnups achieved ranged from ~26500 MWD/Te (fuel) up to ~33000 MWD/Te (fuel). Restructuring occurred in the central region of all pins without the formation of a central hole, and some pin swelling over the fuel stack length was observed up to a maximum of ~6%. There was evidence of migration and loss of higher carbide phases in the pins irradiated at higher temperatures. These pins also have a higher concentration of plutonium in the cooler outer region. The two hottest pins had cladding failures due in part to carburization. (auth)

10381 (KFK-1919) LAYOUT, IRRADIATION, AND POST-IRRADIATION-EXAMINATION OF THE SHORT-TIME, MIXED-CARBIDE-IRRADIATION-EXPERIMENT LOOP-4a. Weimer, P.; Fiedler, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jul 1974. 202p. (In German). Dep. NTIS (US Sales Only) $13.25.

Experiments on mixed carbide fuels were conducted in a short-time-irradiation-facility in FR 2 at Karlsruhe. The starting behavior of mixed carbide as function of gas gap width and species of bonding gas was tested. The irradiation was carried out in the Helium-Loop in the central channel of FR 2. One pin each with an active length of 150 mm was irradiated for 3 or 15 days, respectively. The whole series consisted of 8 specimens. The plutonium content was some 15 w/o and the density of pellets was some 86% T. D. The cladding was an austenitic steel (No. 1.4988). The O.D. of cladding was 10.0 mm with a wall thickness of 0.55 mm. Besides the thermocouples on the cladding the specimen possessed a central thermocouple. The rod power was some 1100 W/cm, the outer cladding temperature 500°C, and the burnup only some 0.2%. Three pins melted near the central thermocouple by an peritectic reaction between thermocouples, cladding and fuel. Results of non-destructive and destructive post irradiation examination are represented. The α-values changed during irradiation (0.5 - 1.5 W/cm^2 °C). No difference could be found between He- or Ar-Bonding for mixed carbide prepared by an industrial process. (auth)

10382 NUCLEAR FUEL ELEMENT. Takeda, K.; Hirose, Y. (to Hitachi Ltd.). Japanese Patent 1973,11274. 18 May 1966. 3p. (In Japanese).

A nuclear fuel element, which is densely filled with powders of different production methods is proposed with a view to reducing the amount of impurities which might otherwise be contained in the fuel element and which are volatile at high temperature. The powders for the fuel element are composed of nuclear fuel powders having a plurality of particle sizes, with the coarser and intermediate powders made of fused nuclear fuel material having high density and the finer powders made of sintered nuclear fuel material. (JA)

10383 ROLE OF THE ACCOMMODATION COEFFICIENT IN CONTACT HEAT EXCHANGE. Kharitonov, V. V.; Kokorev, L. S.; Del'vin, N. N. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1050-1051(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 360-361(Nov 1973).

Heat conduction through a layer is, in the simplest estimate, directly proportional to the thermal conductivity of the layer; however, bench tests and in-reactor experiments indicate that the conduction of heat across a gas-filled fuel-clad gap is independent of the composition of the gas mixture inside the fuel can. An attempt is made to explain this effect by considering features of the interaction of the gas with the boundaries of the gap. It is shown that the accommodation coefficients of different gases are inversely related to their coefficients of thermal conductivity. Thus the heat conduction across the gap should depend only weakly on the composition of the gas. The transport of part of the heat by radiation and through points of direct contact between fuel and clad makes this dependence even weaker. Heat conduction data are presented for gaps containing noble gases. (DG)

10384 NUCLEAR FUEL RODS HAVING END PLUGS WITH BORES THERETHROUGH SEALED BY FRANGIBLE MEMBRANES. Flipot, A. J.; Papeleux, P.; Lafontaine, I. (to Belgonucleaire and Centre d'Etude de l'Energie Nucleaire). US Patent 3,836,431. 17 Sep 1974. Priority date 4 May 1971, Belgium. 4p.

A description is given of a cylindrical, pressurized, nuclear reactor fuel rod sealed at one end by an end plug having a frangible membrane sealing a narrow bore extending through the plug. (Official Gazette)

10385 PROCESS FOR PRODUCING FUEL AND BREEDER BODIES FOR A NUCLEAR REACTOR. Gyarmati, E.; Nickel, H. (to Kernforschungsanlage Jülich). US Patent 3,838,184. 24 Sep 1974. Priority date 3 Dec 1969, F.R. Germany. 6p.

A description is given of a process in which metal-coated or metal-sheathed fuel or breeder cores are made from particles which are piled and, under a vacuum of 10^{-3} to 10^{-5} torr and at a temperature of 800°-2000°C, are sintered under a mechanical pressure of several hundred pounds/cm^2. The composite bodies form fuel elements or parts of fuel elements. The metal covering of the particles has a high melting point and may be molybdenum, zirconium, vanadium or niobium and, at each fusion interface, diffuses with the metal of the neighboring shell. The interstices between the sintered particles form coolant channels. (Official Gazette)

10386 REPLY TO 'COMMENTS ON PAPERS BY OLANDER REGARDING ACTINIDE REDISTRIBUTION IN MIXED-OXIDE FUELS' BY R. O. MEYER. Olander, D. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). J. Nucl. Mater.; 52: No. 2, 329-330(Oct 1974).

Meyer has advanced three criticisms of the models of actinide redistribution in mixed-oxide fuels presented by Olander. The first of Meyer's criticisms is incorrect and the last two are considered trivial. (auth)

10387 COMMENTS ON PAPERS BY OLANDER REGARDING ACTINIDE REDISTRIBUTION IN MIXED-OXIDE FUELS. Meyer, R. O. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 52: No. 2, 326-328(Oct 1974).

In several recent papers Olander discusses actinide redistribution in mixed-oxide fuels and concludes that the migration of closed pores in a radial temperature gradient produces little or no segregation of uranium and plutonium atoms. This conclusion is at variance with the author's current understanding of the phenomenon as well as with the work of others. Significant errors are thought to be present in each of Olander's papers, and these errors are described. Particular attention is given to a calculation that results in the conclusion that no actinide redistribution occurs due to the migration of closed pores—a conclusion that the author believes is not valid. (auth)

10388 BURN-UP DOSE LIMIT OF PYROCARBON-COATED FUEL PARTICLES. Rotterdam, R. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)). J. Nucl. Mater.; 52: No. 2, 317-322(Oct 1974). (In German).

In order to estimate the burn-up/dose limit of fuel particles coated with pyrocarbon, the criterion for particle failure was investigated. Evaluation of the R2-K2 irradiation test (16.6% fima; 6.5 × 10^{21}/cm^2 for E > 0.1 MeV) and theoretical investigations of the burn-up potential of particles of the THTR type indicated that a comparison of maximum-induced tensile stress with the UTS of PyC does not predict any limitation of particle life. While the tensile stress stabilises at a value less than the UTS, the creep strain increases progressively with increasing dose and burn-up. Production variations in particle geometry influence creep strain more than tensile stress. To estimate the life expectancy of these particles it is therefore necessary to take into account the creep strain of PyC and the processes generated by creep. (auth)

10389 UNSTEADY THERMAL STRESSES IN FUEL ELEMENTS UNDER HEAT GENERATION. Takeuti, Y.; Noda, N. (Osaka Prefectural Univ., Sakai (Japan)). Nucl. Eng. Des.; 30: No. 3, 328-338(1974).

In designing some types of fuel elements, it is necessary to find the thermal stresses in a continuous medium perforated by cylindrical channels of circular cross-section. In order to set up the problem, assume that the strength and heat transfer calculation are based on the phenomena that occur in a typical unit lattice cell, and that the heat generation is uniform over the whole section. Therefore, the problems reduce to solving the temperature and thermal stresses in a polygonal prism with a central circular hole under uniform heat generation and for insulated outer boundary. In previous papers the steady thermal stress distribution in such formed regions was obtained by use of the five elementary functions method. In starting up or shutting down of the reactor, however, the problem becomes one of the unsteady state. It is felt that no analysis has been given to the transient thermoelastic problem of the multiply-connected region. The problems considered are concerned with unsteady thermal stresses in a polygonal prism with a circular hole under a uniform heat generation. The solving process is divided into two basic steps. First, the heat conduction equation is solved by the Laplace transform technique. Secondly, the plane thermoelastic problem is solved by use of the five elementary functions method. Throughout the treatment of both problems, in order to satisfy the boundary conditions, the point-matching technique is used in conjunction with the least square method. (auth)

Reactor Control Systems

Refer also to abstracts 8742 and 10307.

10390 (AECL-4578) CONTROL ANALYSIS OF ORGANIC-COOLED NUCLEAR POWER STATIONS. Part 1. Control Analysis of OCR-500. Barclay, F. W.; Mehta, K. K.; Kendall, J. D.; Frey, J. R. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1974. 192p. Dep. NTIS (U. S. Sales Only) $12.75. AECL $4.00.

This report, the first in a series of three, describes in detail the control analyses done for the OCR-500 Power Station Design Study. A mathematical model of most of the major plant components was programmed in the IBM simulation language, CSMP. The individual component models were incorporated into an overall plant simulation program, used to study the dynamic control strategies and controller characteristics which would yield acceptable plant behavior under both normal and abnormal conditions. To validate the simulation program, an independent linear analysis of the OCR-500 system was done, and compared with the simulation model results. The basic equations and models for both the linear and simulation analyses are given along with the results. The linear analysis provides a means of establishing the relative stability of the system for various control system designs while the nonlinear simulation analysis can be used to study the system response to realistic transients. These types of analysis are complementary and provide the information required for an overall understanding of plant controllability. (8 references) (auth)

10391 (BARC-713) WATER CHEMISTRY STUDIES. XII. Chemical Shim Control for Power Reactors: Use of Boric Acid. Mathur, P. K.; Venkateswarlu, K. S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 24p. Dep. NTIS (US Sales Only) $4.25.

A brief review is presented on the use of soluble chemical poisons dissolved in the primary reactor coolant or moderator for the supplementary control of slowly varying reactivity effects (chemical shim) in water cooled and moderated nuclear reactors. Boric acid offers substantial advantages in closed cycle water reactors from the viewpoint of reactor physics. Employed with multiregion or with cycled fuel loading, chemical shim promises better power distribution in the core, increased power density, and reduced control rod requirements at considerable cost savings. Laboratory chemical tests and plant trials have successfully demonstrated the safe operation and economic advantages of this application. It has been shown that addition of soluble poisons to moderator or primary coolant: (1) does not adversely affect core fouling, (2) reduces system contamination and hence increases accessibility, (3) corrosion and wear of otherwise accepted constructional or fuel materials is not made worse, and (4) the compatibility with demonstrated processes of water purification and waste disposal is not worsened. When applied to CANDU-type reactors which have comparatively low reactivity change control requirements, it is possible to remove the poison from the moderator efficiently and essentially completely; there is very little irreversible deposition on calandria tubes; and the radiolytic decomposition of heavy water is not enhanced to any significant extent. (auth)

10392 (GEAP-13824-10) LMFBR ALTERNATE SHUTDOWN SYSTEM DEVELOPMENT AND TESTING. Tenth Quarterly Report, April–June 1974. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Jul 1974. Contract AT(04-3)-893. 19p. AT.

The Alternate Shutdown System (ALSS) design continued. Attention was focused upon various details within the drive mechanism in preparation for detail design. The design was updated to comply with the latest Clinch River Breeder Reactor Plant configuration. Check-out and calibration of the Phase II Damper Test Rig were carried out and fabrication of the Latch Test Rig was continued. Analysis efforts were concentrated upon further scram dynamics predictions for additional transient conditions and upon refinements in the structural analysis of the driveline and control assembly. (auth)

10393 (WCAP-8403) TOPICAL REPORT: POWER DISTRIBUTION CONTROL AND LOAD FOLLOWING PROCEDURES. Morita, T.; Scherpereel, L. R.; Dzikowski, K. J.; Radcliffe, R. E.; Lucoff, D. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Water Reactor Divisions). Sep 1974. 154p. Dep. NTIS $10.75.

A core control strategy based upon constant axial offset control (or target flux difference control) is presented. This strategy allows the use of a low upper bound on the nuclear heat flux hot channel factor during normal operation (hence maximizing the margin to core safety limits) while permitting the maintenance of necessary load follow flexibility. Constant axial offset control may be effectively accomplished with or without the use of the part-length control bank, the only difference being in the rate of return to full power following part-power operation. The rate of return is faster when the part-length bank is used. The benefits of constant axial offset control are demonstrated in this report by the study of typical Westinghouse PWR plants, and results are given which show the applicability of the methods of analysis to all present and immediately forthcoming plants. (auth)

10394 CONTROL OF REPETITIVE-ACCELERATOR FAST-PULSED REACTOR. Yoshikawa, H.; Wakabayashi, J. (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 11: No. 5, 187-198(May 1974).

Control algorithms are proposed for on-line computer control of the repetitive-accelerator fast-pulsed reactor. Simplification of the reactor core dynamics is obtained by regression analysis technique in order to obtain a compact model of the pulsed reactor. A start-up control algorithm to avoid severe thermal shock in the fuel rod is proposed. This is essentially a programmed control, whereby the external neutron source from the accelerator and the external reactivity are controlled in such manner that the fuel temperature would follow a predetermined time trajectory. Applicability of the method to the reactor start-up is proved by a computer simulation experiment. A control concept for constant power operation is proposed. This is composed of two control loops: (1) a fine control loop, which responds quickly to small variations of reactor power, and (2) a diagnosis and adaptation loop, which judges whether a large deviation from set-up value observed on the reactor power output is due to an abnormality in the external neutron source, or to a change of the set-up value itself, and then adaptively returns the reactor power to the set-up value. A computer simulation experiment demonstrated the validity of the control system characteristics. A discussion is also presented on the problems foreseen in applying the proposed methods to the actual design of a digital computer control system. (auth)

10395 CONTROL ROD FOR NUCLEAR REACTORS. Suvanto, A. (to Aktiebolaget Asea-Atom). US Patent 3,834,986. 10 Sep 1974. Priority date 11 Oct 1971, Sweden. 2p.

In order to provide more efficient use of control rods for nuclear reactors, attachment means at both ends are provided for attachment to a movable holder such as a movable shaft. Thus the rods may be reversed when one end is spent, while the other end still has useful life. (Official Gazette)

10396 COMPUTER CONTROL AT BRUCE NUCLEAR GENERATING STATION. Morris, D. I. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Safety; 15: No. 6, 691-701(1974).

The 3000-MW(c) Bruce Nuclear Generating Station, scheduled to go critical in September 1975, utilizes direct digital control for reactor regulation and electric-power output in a reactor following turbine mode. The design and operating philosophies have been implemented successfully at other nuclear stations which are presently producing power. The computers, peripherals, and software operating system are designed to provide a variety of hardware and software self-checking functions so that transfer of control to the standby system can be carried out automatically and can be either partial or total, depending on which the particular failure mode warrants. The main task of the dual digital computers is to provide unit reactor power regulation to control the generation of electric power to an operator-entered value. A number of functionally independent programs provide direct digital control in the form of analog or digital outputs to devices in the field, so that the entire operation from reactor warmup to 100% electric-power output is done without operator intervention. The majority of the alarm annunciation requirements for the generating unit are handled by the control computers utilizing high-speed printers and cathode-ray-tube displays. An extensive operator interactive graphical display system, which has reduced the congestion of control-panel instrumentation, has been incorporated in the unit's digital-control computer system. (auth)

Nuclear Power Plant Economics

Refer also to abstract 10297.

10397 (BARC-723) ECONOMICS OF INTEGRATING A LARGE POWER STATION IN A GROWING GRID. Balakrishnan, M. R.; Meckoni, V. N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 20p. Dep. NTIS (US Sales Only) $4.00.

There may be certain circumstances under which it may not be desirable to introduce a single large generating unit on an existing grid system, either due to the relatively small size of the grid, or due to lack of immediate load demand. However, within a few years the load demand may adequately increase and the grid capacity may grow to such an extent that it can accept a large generating unit. Even when the grid can not accept a single large unit and the load demand does not warrant the installation of a large unit, it may be economically more attractive to install a large single unit power station and to operate it at reduced capacity for a few years until the load increases and the grid capacity grows. The decision on whether to install a large single generating unit or not, depends on whether the reduction in the specific capital cost of a large generating unit is adequate to compensate for the loss of return on part of the capital investment during the first few years after the investment. This again depends on the number of years for which the station has to operate at reduced capacity. A method is presented to analyze this particular problem and is illustrated by considering a specific example of a 500 MW(e) and a 250 MW(e) CANDU type nuclear power stations. Under the assumptions made, it is seen that installing a 500 MW(e) station and operating it at 250 MW(e) for the first few years is more economical than adding 250 MW(e) stations, provided the 500 MW(e) unit can be operated at its full capacity within five years from commissioning. (auth)

10398 NUCLEAR DEVELOPMENT UNDER ENERGY CRISIS. Murata, H. (Japan Atomic Energy Research Inst., Tokyo). Genshiryoku Kogyo; 20: No. 2, 13-16(Feb 1974).

In the face of the current energy crisis, nuclear energy is destined to play its role. In this connection, two major problems are preservation of environment and economy of fuel utilization. From the long-range point of view, nuclear fusion development must be pursued even more than nuclear fission development. To meet the energy needs in the foreseeable future, nuclear fission reactors must be multipurpose for the efficient utilization of fuel. Nuclear power development under the energy crisis is analyzed from the standpoints of nuclear power and energy resources, the countermeasures for the energy crisis, the direction of nuclear power development, and the strategy for power reactor development. (JA)

10399 POWER IN THE MARITIMES. Mod. Power Eng.; 68: No. 8, 57-68(Aug 1974).

In order to meet increasing power demands in the Maritimes, these provinces are taking steps to meet the demands. Hydroelectric, nuclear, and fossil generating potential is to be expanded. Presently underway is the Coleson Cove, 4 × 315 MW fossil fuel station, and a 200-MW extention to the Dalhousie fossil fuel plant is planned. Construction of New Brunswick's first nuclear generating station at Point Lepreau with 2 × 600-MW capacity is expected to begin shortly. The automated heavy water plant at Point Tupper will have produced over 360 tons of D_2O by the end of 1974. Rehabilitation of the Glace Bay heavy water plant is expected to be complete by 1975. Nuclear power will play a larger role in future power production in the Atlantic provinces. (CA)

10400 ECONOMIC FEATURES OF NUCLEAR POWER PLANTS WITH THERMAL AND FAST BREEDER REACTORS. Mojovic, L. J. Elektroprivreda; 26: No. 3-4, 103-110(1973). (In Slovak).

The basic economic relations and the costs of nuclear fuels for atomic power plants are discussed. The economics of large power generating stations as well as the competitiveness of nuclear power plants are analyzed. The distinctive relations between economic features of nuclear and thermal power plants are indicated, and the trend towards the development of fast breeder reactors and their economics are discussed in more detail. (Bull. Sci. Sect A)

10401 PRESENT AND FUTURE ROLE OF NUCLEAR ENERGY. Silvestri, M. (CISE-Segrate, Milan). Energ. Nucl. (Milan); 21: No. 11, 607-616(Nov 1974). (In Italian).

A discussion is presented that deals with the most outstanding aspects and problems associated with the present and the future of nuclear power: present world production of nuclear power and its foreseeable evolution within the next decade, with particular regard to Italy; present and potential uranium resources, and possibilities of integral exploitation of this material in reactors through breeding; possible extensions of the use of nuclear power in new areas, such as ship propulsion and hydrogen production; hazards linked with nuclear power, such as radioactive emissions, waste disposal accidents and thefts of fissile material. Confidence is expressed in the future of nuclear energy, which—in the authors opinion—could assume, thanks to breeding, the characteristics of a "perennial" source, while the relevant risks could be effectually neutralized. (auth)

10402 U.S. NUCLEAR POWER-PLANT AVAILABILITY AND CAPACITY STATISTICS FOR 1973. Nucl. Safety; 15: No. 6, 738-741(1974).

Statistical information concerning nuclear power-plant availability, plant capacity, and reactor availability factors for 1973 was compiled from semiannual reports submitted to the U. S. Atomic Energy Commission (AEC). Statistics showed that plant availability during 1973 was slightly lower than that reported for 1972. A previous observation concerning attainment of, and continued performance at, 80% availability after 3 to 4 years' operation was not substantiated by experience during 1973 because of extensive outages at a few plants that strongly influenced the averages for the small number of plants that have been in operation for 3 years or more. However, plant availability and capacity factors for nuclear power plants are comparable to those reported elsewhere for fossil-fueled power plants of comparable sizes and ages. (auth)

Reactor Licensing and Regulation

10403 (FIND-50237(10-74)) FIND: DRESDEN NUCLEAR POWER STATION, UNIT 2. Carter, E. P. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Oct 1974. 43p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

10404 (REG/G-1.70.11(12-74)) INFORMATION FOR SAFETY ANALYSIS REPORTS: QUALITY ASSURANCE DURING OPERATIONS PHASE. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1974. 4p. DRS Free.

Guidelines for providing information in safety analysis reports on operational quality assurance are presented. (JMR)

10405 (REG/G-1.70.12(12-74)) INFORMATION FOR SAFETY ANALYSIS REPORTS: REACTOR MATERIALS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1974. 4p. DRS Free.

Guidelines for providing information in safety analysis reports on reactor materials are presented. (JWR)

10406 (REG/G-1.70.13(12-74)) INFORMATION FOR SAFETY ANALYSIS REPORTS: CODE CASES APPLICABLE TO REACTOR COOLANT PRESSURE BOUNDARY COMPONENTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1974. 3p. DRS Free.

Guidelines are presented for providing information in safety analysis reports on code cases applicable to reactor coolant pressure boundary components. (JWR)

10407 (REG/G-1.70.14(12-74)) INFORMATION FOR SAFETY ANALYSIS REPORTS: EMERGENCY PLANNING. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1974. 5p. DRS Free.

Guidelines for providing information in safety analysis reports on emergency planning are presented. (JWR)

10408 BENEFIT-COST ANALYSIS IN LICENSING OF NUCLEAR POWER REACTORS. Hill, R. M.; Bryan, R. H.; Nichols, B. L. (Oak Ridge National Lab., TN). Nucl. Safety; 15: No. 6, 665-673(1974).

The evolution of a method used to develop benefit-cost analyses for inclusion in environmental statements prepared for the AEC Directorate of Licensing is described. The following are discussed: (1) the history of the federal government's development of benefit—cost analyses for water-resources projects, (2) the effect of the Calvert Cliffs case on AEC licensing activities, (3) the development of AEC guides for preparation of environmental reports and benefit—cost analyses and their effect on other activities, and (4) some possible trends in the development and use of benefit—cost analyses developed for environmental reports and statements. (auth)

GENERAL AND MISCELLANEOUS

Civilian Defense

10409 (AD-778284) SOME DATA ON THE NUMBER, LOCATION, USE, AND PHYSICAL CHARACTERISTICS OF MOTOR TRUCKS IN THE UNITED STATES. (Stanford Research Inst., Menlo Park, Calif. (USA)). Nov 1961. Contract CDM-SR-61-62. 63p. NTIS $6.25.

The objective is to analyze the major modes of transportation in U.S. with particular reference to the effects of a nuclear attack on the transportation resources, assessment of damage for a range of attacks, estimation of the capability of the post-attack transportation system and its comparison with the estimated demand in the post-attack period, and measures that might enhance post-attack transportation capability. (GRA)

10410 (AD-784599) EXPERIMENTAL EVALUATION OF DCPA (DEFENSE CIVIL PREPAREDNESS AGENCY) STANDARD METHOD CALCULATIONS FOR BASEMENT CORE STRUCTURES. Final Report. Schmoke, M. A.; Post, W. J. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Aug 1974. 59p. (BRL-1736). NTIS $3.75.

The objective of this experiment was to test the validity of the DCPA standard method calculation of the fallout radiation protection afforded by core structures or shelters in basements where belowground interior partitions are involved. Gamma radiation measurements were made within the basement core of an experimental building which was located in a fallout field simulated with a circulating point source of cobalt 60. Data were converted to reduction factors (the ratio of the shielded exposure rate to the free field exposure rate) and compared the reduction factors calculated using the DCPA standard method and two modifications of the standard method. (auth)

Energy Utilization and Economics

10411 (BNL-19249) HYDROGEN STORAGE AND PRODUCTION IN UTILITY SYSTEMS. First Annual Report, November 1, 1973–June 30, 1974. Salzano, F. J. (ed.). (Brookhaven National Lab., Upton, N. Y. (USA)). Jul 1974. 87p. Dep. NTIS $7.50.

Progress is reported in a program for the development of the technology of electrolytic hydrogen production, storage, and reconversion to electricity as a technique for electric energy storage. The program, initiated on November 1, 1973, emphasizes the use of metal hydrides (particularly iron-titanium) for hydrogen storage. (LK)

10412 (BNWL-SA-5070) ENERGY AND FIXED NITROGEN FROM AGRICULTURAL RESIDUES. Rohrmann, C. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 18p. (CONF-740732-1). Dep. NTIS $4.00.

From annual meeting of the Western Argicultural Economics Association; Moscow, Idaho, USA (26 Jul 1974).

The review examines the nature of agricultural residues from the standpoint of carbon content, indicates how this carbon may be converted to a useful energy form and/or processed to principal forms of fixed nitrogen fertilizers, points out the potential or capable magnitude of such conversions based on wheat straw, and identifies the principal economic and engineering problems to be solved in order to acheive such production. Conversion of the organic and carbonaceous constituents of agricultural residues into a gaseous form, primarily hydrogen and carbon monoxide, is followed. These gaseous mixtures are processed or reconstituted to yield methanol and/or mixed with air to yield anhydrous ammonia. An investigation of Pacific Northwest wheat production in the light of a conclusion that American agriculture used energy inefficiently is made. It is shown that the energy value of the wheat produced exceeds the energy inputs in the form of fuel and fertilizer by a factor 22.5 and this does not include any of the recoverable fuel value in the straw that greatly exceeds that of the grain. Although there are major political, engineering, and economic problems, the near future and long-range energy and fertilizer situations may be alleviated by the carbon resource that exists in the form of recoverable agricultural wastes. (MCW)

10413 (LA-UR-1586) HYBRID COMPUTER SIMULATION OF TRANSMISSION LINE CIRCUITS. Murray, H. S.; Hafer, J. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 9p. (CONF-741001-22). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

A transmission line modeling technique, in which the voltage and current transfer functions are decomposed into pure time delays plus approximate rational polynomial transfer functions, is used to simulate transmission line circuits on a hybrid computer. The rational transfer functions are implemented on the analog computer while the time delays are generated on the digital computer. The method is used to study the response of transmission line circuits consisting of multiple parallel and series lines with complex source and load impedances. The effect of slight variations in delay times and characteristic impedances between parallel lines is studied with respect to the shape of the total load current steps. Transfer function fitting techniques are discussed for the purpose of arriving at polynomial approximations, and some generalized fits are presented in terms of dimensionless frequencies which are normalized with respect to the parameters of the transmission line. Time delay generation and other considerations of hybrid implementation are detailed. (auth)

10414 (UCID-16591) ACOUSTIC ARRAY METHODS FOR INSTRUMENTATION OF IN SITU COAL GASIFICATION. Sherman, J. W.; Woods, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Oct 1974. Contract W-7405-eng-48. 14p. Dep. NTIS $4.00.

Geophysical and seismic signal processing are reviewed. The assumed physical properties of the coal burn front are discussed. Several ways in which acoustic arrays can be used for in situ coal gasification are presented and discussed. (auth)

10415 (UCID-16631) METHODICAL APPROACH TO TEMPERATURE AND PRESSURE MEASUREMENTS FOR IN SITU ENERGY-RECOVERY PROCESSES. Cornell, R. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Nov 1974. Contract W-7405-eng-48. 7p. Dep. NTIS $4.00.

Continuous monitoring of temperature and pressure is critical to in situ energy-recovery processes. Because of the harsh environments to which the instruments will be subjected and the difficulty of emplacing them, a methodical approach to an instrumentation plan is necessary. The aspects of such a methodical approach and areas that will require consideration are discussed. (auth)

Information Handling

10416 (LA-5777-MS) PUBLICATIONS OF LASL RESEARCH, 1973. Kerr, A. K. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 368p. Dep. NTIS $10.60.

The bibliography lists unclassified 1973 publications of work done at the Los Alamos Scientific Laboratory and any earlier publications received too late for inclusion in earlier compilations. Papers published in 1973 are included regardless of when they were actually written. All classified issuances are omitted. Declassification of previously classified reports is considered to constitute publication. Because of a large effort to declassify reports in 1973, the bibliography lists over 600 such declassified reports, many of which were written in the early years of the laboratory. The bibliography includes Los Alamos Scientific Laboratory reports, papers released as non-Los Alamos reports, journal articles, books, chapters of books, conference papers whether published separately or as part of conference proceedings issued as books or reports, papers published in congressional hearings, theses, and U. S. patents. Publications by LASL authors which are not records of Laboratory-sponsored work are included when the Library becomes aware of them. There is a Keyword-in-Context index, plus a list of words not included in that index. (MCW)

10417 (TID-85-R11) REPORT NUMBER CODES USED BY THE USAEC TECHNICAL INFORMATION CENTER IN CATALOGING REPORTS. White, H. W.; Cockrell, E. (comps.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Dec 1974. 191p. Dep. NTIS $7.60.

Each report processed by the Technical Information Center is identified by a unique report number consisting of a code plus a sequential number. In most cases, the code identifies the originating installation. In some cases it identifies a specific program or a type of publication. Listed are all codes that have been used by the AEC in cataloging reports. In recent years, it has been the policy of the AEC, insofar as possible, to limit the assignment of report codes to one per installation. The majority of the codes listed originated before control was established, and are no longer in use. They continue to be listed, however, because most of the reports to which they are assigned are still in existence. The compilation consists of two parts. Part I is an alphabetical listing of report codes identified with the issuing installations which have used the codes. Part II is an alphabetical listing of installations identified with codes each has used. When more than one code has been assigned to a report, one has been selected as the primary identifier and is so listed in Part I (prefixed by a plus sign). All other codes are listed in Part II as secondary (without a footnote symbol). In both Parts I and II, the names of issuing installations appear for the most part in the form used at the time the reports were issued. For some of the more prolific installations which have had name changes, however, all entries have been merged under the current name. (auth)

10418 (UCC-ND-286) INDEX OF INDUSTRIAL COOPERATION BULLETINS, NOVEMBER 1971–MAY 1974. Read, A. M. (comp.). (Oak Ridge Y-12 Plant, Tenn. (USA)). 26 Sep 1974. Contract W-7405-eng-26. 39p. Dep. NTIS $5.00.

The index cites Industrial Cooperation Bulletins issued quarterly during the period from October 1971 through May 1974 which briefly describe new developments that are potentially valuable to state and local governments and which have a high potential for industrial application, either for in-house use or as a new product. It consists of two sections: a permuted title index and a bibliographic section. Each bibliographic entry is arranged according to bulletin number and includes a title, abstract, and report availability. (auth)

10419 NEW POSSIBILITIES OF IMPROVED INFORMATION ON NUCLEAR RESEARCH AND NUCLEAR TECHNIQUES THROUGH INIS INFORMATION SERVICE. Isotopenpraxis; 10: No. 8, 312(Aug 1974). (In German).

The services available through INIS, which covers a significant portion of the world's literature on nuclear science, are briefly outlined. The DDR has taken the first steps to avail itself of the data available on magnetic tape from INIS. (JSR)

Law

10420 (SZS-157, pp 191-192) NEW REGULATIONS ON RADIATION PROTECTION IN CZECHOSLOVAKIA AND POPULATION PROTECTION. Kunz, E. (Institut fuer Hygiene und Epidemiologie, Prague). Mar 1974. (In German).

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

The regulations which became effective in Czechoslovakia in 1972 are briefly summarized with an indication of the effects they will have on installations releasing radioactive materials to the environment. (JSR)

10421 (SZS-157, pp 199-206) ANALYSIS AND SELECTION OF ENVIRONMENTAL PROTECTION GUIDES FROM ACCIDENTAL FISSION PRODUCT RELEASES FOR POLISH CONDITIONS. Pensko, M.; Nowicki, K. (Inst. of Nuclear Research, Swierk, Poland). Mar 1974.

From first seminar on the radiation protection, environment, and the population; Potsdam, German Democratic Republic (16 Oct 1972).

In this paper the proposals of criteria and recommendations of the application of ERLs in Poland in the case of uncontrolled release of significant amounts of radionuclides from nuclear reactors were presented and discussed. The basic figures of Emergency Reference Levels for doses to critical organs were adopted accordingly to United Kingdom experience and recommendations. The inferred numerical values of secondary guides calculated for Polish conditions are nearly the same as in Great Britain. The slight differences appeared in ERLs for ingestion of ^{131}J with milk by infants who are fed mostly with powdered milk in this country. The other difference lies in slightly higher concentration of ^{131}J and other critical radionuclides in milk as well as higher contamination level of grass which could be adopted as Emergency Reference Levels in the case of ingestion hazard for Polish conditions. This is because the grazing area of cows is less than 160 m^2/day for most regions in Poland. The Emergency Reference Levels for ingestion hazard proposed in this paper contain therefore the greater margins of safety for Polish conditions than in Great Britain. The acceptance of the above mentioned ERLs has a very practical meaning. It would simplify the work of nuclear energy plant designers as well as radiation protection monitoring services. The comparison of ERLs with calculated values of doses and contaminations occurring during the postulated Maximum Credible Accident (MCA) would permit the designer to select the best possible concept of design and construction of the whole facility as well as engineered safeguards. On the other hand a similar comparison with the values received during field measurements in the first period after an accidental release of fission products into the atmosphere gives sufficient basis to radiation protection officers and local authorities for making the appropriate decisions and applying the most efficient safety precautions. This must be undertaken with careful consideration because it involves often significant costs. In order to make such a comparison one should apply the appropriate measurement and calculation method, which can be found in literature. (auth)

10422 SPECIAL JURIDICAL COMMITTEE OF THE CIEN. How it is Supported and How it is Used. Guimares, R. Jr. (CIEN, Sao Paulo, Brazil). Cienc. Interamer.; 14: No. 3-6, 11-14(1973). (In Portuguese).

The countries of Latin America will encounter in the immediate future enormous national and international problems involving nuclear energy. The creation of a special juridical committee can assist in solving many of the legal problems arising. The specific areas in which this committee can be helpful are outlined. The organization of the committee is indicated. (JSR)

10423 REGULATION OF NUCLEAR POWER REACTORS AND RELATED FACILITIES. At. Energy Law J.; 16: No. 3, 256-292 (Fall 1974). (WASH-1250).

The U. S. Atomic Energy Commission (AEC) has the responsibility to protect the health and safety of the public by assuring that an owner/operator designs, builds, and operates, and maintains the integrity of, a nuclear facility over its lifetime in accordance with the criteria, codes, standards, and regulatory judgments directed toward that end. The philosophy and means for protecting the public health, the relevant AEC rules and regulations, the details of the licensing process, and the AEC inspection program are summarized. (auth)

10424 AEC STAFF STUDY OF THE PRICE–ANDERSON ACT. I. At. Energy Law J.; 16: No. 3, 205-255(Fall 1974).

The study examines whether there remains a continued need for government indemnity as provided under the Price-Anderson Act. The Act affords financial protection to the public and to AEC licensees and contractors against public liability risks associated with atomic energy. It provides for private insurance and governmental indemnity amounting to a maximum of $560 million to cover public liability claims that might conceivably arise from a nuclear incident. The indemnity provisions of the Act apply only to licenses issued by the AEC and contracts executed by the AEC prior to August 1, 1977. Whether the objectives of the Act continue to be appropriate in relation to the needs of the 1970s is examined. (MCW)

10425 MERCHANT MARINE MISCELLANEOUS. Part 2. Hearings Before the Subcommittee on Merchant Marine and the Committee on Merchant Marine and Fisheries, House of Representatives, Ninety-Third Congress, on Container Barge Service, June 15, 1973; Nuclear Vessel Incentive, November 7, 8, 1973; SS Guam Bear and SS Hawaii Bear, December 5, 1973; Miss KEKU-Marine Trade-in-1974 Supplemental Authorization: H.R. 12627, H.R. 12427, and H.R. 12925, February 25, 1974; Maritime Authorization–F.Y. 1975, April 23, 1974. Washington, DC; Committee on Merchant Marine and Fisheries (1974). 303p. GPO.

The hearing held June 15, 1973 dealing with container barge service dealt with conferring exclusive jurisdiction on the Federal Maritime Commission over certain movements of merchandise by barge in foreign commerce. The hearings on November 7 and 8, 1973 dealing with nuclear vessel incentive were conducted to outline the feasibility of a nuclear merchant fleet. The hearing on December 5, 1973 dealing with the SS "GUAM BEAR" and the SS "HAWAII BEAR" was conducted to broaden the scope of the law allowing the two ships to conduct business only between the U. S. and Guam. A change in the requirements of the statute is deemed necessary should the sale of the fleet be made to a purchaser other than their successor in the service, or for operation in some other trade. The hearing on February 25, 1974 met to discuss legislation documenting the vessel Miss Keku as a vessel of the U. S. and so to be entitled to engage in American fisheries. The hearing also dealt with some legislation regarding scrapping of vessels and their prices. The last hearing dealt with the funding of the Maritime Administration for 1975. (MCW)

Management

10426 (CONF-741041–1) MOTIVATIONS AND EXPECTATIONS. Carter, H. P. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Computer Sciences Div.). 1974. 5p. Dep. NTIS $4.00.

From conference on atomic energy systems, operations, and programming focus on management issues; Bethesda, Maryland, USA (23 Oct 1974).

Motivations for resource sharing and problems they create are discussed. The most common motivation is excess capacity or the lack of capacity. A second motivation is the sharing of large unique data files and programs. A third motivation is the desire to use peculiar hardware not available at your site. The final motivation comes from the cost of acquiring and operating computers and a hoped-for saving based on the economics of size. (MCW)

10427 (DEU-73-1) BUDGET FOR THE PROGRAM 1973. Planning Period 1972-1976. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). 1972. 41p. (In German).

A compilation is presented of medium-range plans for research and development at the Hahn-Meitner Institute. The main topics of research are described in terms of motivation, state-of-the art, feasibility, cooperation etc. until 1976. The main topics are arranged into 3 groups: basic research (nuclear structure, radiation effects on matter, environment,nuclear solid-state physics), new technologies (electronic equipment in outer space conditions, cyclotron improvements), and data processing (process control including appropriate languages, user and operating systems). (GE)

10428 (DEU-73-8) RESEARCH AND DEVELOPMENT ACTIVITIES IN 1971. Report of the Scientific Results. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). May 1972. 310p. (In German).

A detailed report of scientific results is given, arranged by projects, institutes, and departments. A complete list of publications (conference papers, reports, books, patents, journal articles) is included. (GE)

10429 (DEU-73-9) ANNUAL REPORT 1971. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1972. 213p. (In German). (KFK-1670).

This report contains detailed information on research facilities (NS OTTO HAHN, FRG-1, FRG-2, ANEX, hot cells, computers etc.) and R and D activities (operation and second core of NS OTTO HAHN, materials research, marine technology, water desalination, HTR). Information is given on cooperation with industry, universities, organizational structure, budget, personnel, and publications. (GE)

10430 (DEU-73-11) REPORT OF ACTIVITIES IN 1971 OF THE INSTITUTE FOR NUCLEAR ENERGETICS AT THE STUTTGART UNIVERSITY. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). 1972. 32p. (In German).

A general part reports on activities in research, training, and education of the Institute for Nuclear Energetics and contains information on budget, personnel, and organizational structure. The special part contains reports of the activities of the 4 departments: energy conversion/thermal engineering (materials, thermionics, thermohydraulics), reactor physics (dynamics and nuclear data), numerical calculations (e.g. diffusion and heat transfer), and high-temperature technology (joining of refractories). A list of publications supplements each part. (GE)

10431 (DEU-73-28) BUSINESS REPORT 1972. (Kraftanlagen A. G., Heidelberg (F. R. Germany)). 1973. 34p. (In German).

The report on the 51st business year contains accounts of the board of supervisors, the board of directors as well as of the annual budget (assets/liabilities and profits/losses calculation). The nuclear technology field is not particularly mentioned. (GE)

Mathematics and Computers

Refer also to abstracts 8870 and 10150.

10432 (AAEC/E-316) STATISTICAL DISTRIBUTION FUNCTIONS FOR PRODUCT RATIOS AND SUMS OF PRODUCT RATIOS. Rose, E. K.; Cook, J. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

The statistical distributions for product ratios and sums of product ratios are discussed and formulae are given for the computation of special moments, which have to be defined because the usual definition of moments diverges for such distributions. (auth)

10433 (ANL-8040(Suppl. 2)) USAEC COMPUTER PROGRAM SUMMARIES. Numbers 124 Through 176. (Argonne National Lab., Ill. (USA)). Oct 1974. Contract W-31-109-eng-38. 63p. Dep. NTIS $5.45.

The report contains summaries of computer programs at the specification stage, under development, being checked out, in use, or available at Commission offices, laboratories, and contractor installations on problems in nuclear physics, reactor design, reactor engineering, and operation. The purpose of the report is to keep the U. S. AEC, AEC-laboratory, and contractor personnel informed as to the existence, status, and availability of computer programs within the agency. (MCW)

10434 (BDX-613-1235) MAINTENANCE STANDARDS AND COMPUTERIZED SCHEDULING. Hudgins, D. W. (Bendix Corp., Kansas City, Mo. (USA)). 24 Sep 1974. Contract AT(29-1)-613. 27p. (CONF-740958-1). Dep. NTIS $4.00.

From machine tool maintenance seminar; South Bend, Indiana, USA (24 Sep 1974).

Two development programs were designed to provide improved planning and cost control of plant maintenance activities. These programs involve the establishment of work standards, and a computerized work scheduling system. The first phase of this plan was implemented in February 1974, and covered activities related to plant rearrangement. (auth)

10435 (CONF-740845-1) KAPPA RELEASE OF SPEAKEASY. Chan, S. P.; Clifford, J.; Gallagher, K.; Stob, M. (Argonne National Lab., Ill. (USA)). 1974. 26p. Dep. NTIS $4.50.

From 43rd share conference; Chicago, Illinois, USA (26 Aug 1974).

The new features in the KAPPA release of Speakeasy are demonstrated. Speakeasy allows the user to easily access the large amount of information in a computer system. This information is in the form of compiled algorithms, documents, data, and tutorial aids. A printout of a session at a TSO terminal using the new KAPPA version of Speakeasy is presented. It was run in a 200-K region in a TSO environment. (MCW)

10436 (CONF-740846-1) SIGNIFICANCE OF SYMMETRY IN MULTIPLE FRACTURE ANALYSIS. Chopra, P. S. (Argonne National Lab., Ill. (USA)). 1974. 15p. Dep. NTIS $4.00.

From conference on symmetry, similarity and theoretic methods in mechnics; Calgary, Canada (19 Aug 1974).

The finite element method is used to investigate symmetrical and nonsymmetrical branch and secondary crack formation. Using an energy rate fracture approach it is demonstrated that nonsymmetric multiple fracture configurations have a higher probability of formation and propagation. (auth)

10437 (COO-3077-64) SYSTEMS PROGRAMMING LANGUAGES AND GRAPHICS TERMINALS. Stuart, T. (New York Univ., N. Y. (USA). Courant Inst. of Mathematical Sciences). 1974. 24p. (CONF-740569-1). Dep. NTIS $4.25.

From 2nd annual AEC scientific computer information exchange meeting; Upton, New York, USA (May 1974).

Faced with the design of an interactive graphics system, many researchers with widely differing applications have settled on a random access CRT display attached to a miniprocessor. In most cases this small computer is in turn linked to a larger time-shared facility, and the software implications of this overall hardware design are indicated. The advantages and disadvantages of the insertion of the small computer between the display device and the applications oriented large computer are outlined. The use of the specific language, LITTLE, is described briefly. (MCW)

10438 (COO-3077-66) USE OF SPARSITY IN THE SOLUTION OF FINITE ELEMENT SYSTEMS OF EQUATIONS BY GAUSSIAN ELIMINATION-TYPE METHODS. (New York Univ., N. Y. (USA). Courant Inst. of Mathematical Sciences). 1974. Contract AT(11-1)-3077. 35p. (CONF-740236-1). Dep. NTIS $4.75.

From seminar on modern numerical methods; Caracas, Venezuela (18 Feb 1974).

The problems of numerical linear algebra that arise when elliptic problems in two-space dimensions are discretized by finite element (or finite difference) methods are discussed. It is assumed that the problems have real, symmetric coefficient matrices. This is a natural assumption because the standard finite element problems are derived from a variational principle. The finite element matrices have a very special sparsity, i.e. zero - nonzero, structure that is a reflection of the formulation of the original problems of continuum mechanics in terms of partial differential equations, as well as the choice of trial functions that are linear combinations of basis elements which vanish outside a few neighboring elements. The standard five-point difference approximation of Laplace's equation serves as a useful model. (MCW)

10439 (COO-3288-28-1) EMULATION ORIENTED, DYNAMIC MICROPROGRAMMABLE PROCESSOR, VERSION II. Neuhauser, C. (Johns Hopkins Univ., Baltimore, Md. (USA)). Jul 1974. Contract AT(11-1)-3288. 55p. Dep. NTIS $5.75.

The update specifies the design of a low cost, dynamic microprogrammable processor intended primarily as a tool for research and instruction. Changes include: specification of extended arithmetic operations (e.g. multiply), changes to method of accessing memory, specification of additional A-machine instructions, simplification of I/O structure, specification of host machine bus structure, and ISP-like description of the three internal submachines. (auth)

10440 (COO-3288-31) JHU UNIVERSAL HOST MACHINE II. Part I. The Machine. Davison, J. W. (Johns Hopkins Univ., Baltimore, Md. (USA)). Mar 1974. Contract AT(11-1)-3288. 33p. Dep. NTIS $4.75.

The current simulator is designed to be more easily adapted to new machines. The simulator is written in FORTRAN IV and assembly language. The simulator will now model any machine with a word the same size or smaller than that of the base machine (currently 36 bits on a 7094). The advantage here is that if, as with JHUHM II, the simulated machine has a shorter word-length than the base machine, the microprogrammer may ignore completely the base machine and program only the simulated machine. Otherwise, the programmer must be aware of the length of words in the base machine, especially when shifting or rotating data. (MCW)

10441 (COO-3288-32) COMPLETE MODEL FOR REPRESENTING THE COORDINATION OF ASYNCHRONOUS PROCESSES. Agerwala, T. (Johns Hopkins Univ., Baltimore, Md. (USA)). Jul 1974. Contract AT(11-1)-3288. 60p. Dep. NTIS $6.00.

The notion of a coordination system is formalized. A model for representing coordinations is complete if it can represent all possible types of interactions between a group of processes and if it provides a formal counterpart to the notion of coordination. Three models are presented, each arising out of different motivations and each apparently complete. The Turing machine model appears to be complete because of the close relation between the notions of algorithm and coordination. It has been indicated that the extended Petri net model may be complete. Starting from the intuitive description of a coordination system the SS model is defined. This model also provides a generalization of all existing synchronizing primitives. Its generality indicates that it might also be complete. (MCW)

10442 (COO-3288-33) EVALUATION OF JHU MICROMACHINE EMULATION OF THE PDP-11. Bradley, S. Jr.; Neuhauser, C. (Johns Hopkins Univ., Baltimore, Md. (USA)). Sep 1974. Contract AT(11-1)-3288. 40p. Dep. NTIS $5.00.

A skeleton emulation of a DEC PDP-11 series machine on the JHU micromachine is given and evaluated. The report contains a short description of the microassembly language, skeleton emulation of the PDP-11, description of emulator and techniques used, and timing estimate and evaluation of micromachine performance. The emulation indicates that the instruction execution rate of the emulated machine is about one-half to one-third that of a PDP-11/20. Architectural improvements are recommended which will allow the emulated machine to execute PDP-11/20 code in approximately real time. (auth)

10443 (COO-3288-34) STUDIES IN THE ORGANIZATION OF COMPUTER SYSTEMS. Final Report, June 15, 1970 - December 31, 1974. Flynn, M. J. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1974. Contract AT(11-1)-3288. 32p. Dep. NTIS $4.75.

The project has studied theoretical and practical methods for the categorization, analysis, and synthesis of computing systems. In particular, parallel processors were studied as to communications and processing efficiency; including an evaluation of stepping and splitting efforts. Later, the more general problems of interaction between concurrent processes were analyzed and a significant new computationally complete control mechanism was developed. Recent project emphasis has focused on the development of an emulation laboratory for the analysis of computer architectures and certain language iteractions. The project terminates at Johns Hopkins at the end of 1974. (auth)

10444 (COO-3288-35) ANALYSIS OF CONTROLLING AGENTS FOR ASYNCHRONOUS PROCESSES. Agerwala, T. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Electrical Engineering). Aug 1974. Contract AT(11-1)-3288. 87p. Dep. NTIS $7.50.

A first step towards establishing a uniform underlying theory for the study of asynchronous systems is presented. The results show the close relationship between various models. Future studies should be directed towards establishing a theory for modelling, analyzing, synthesizing, and understanding systems of asynchronous processes. The final hierarchy of nets and the relative positions of different controlling agents with respect to the hierarchy is given. At the top of the hierarchy is seven models, PE, V primitives, ASSM, ATMC, LGCS, GKMPS, TN_{EXT}, and BSPN. Of these PE, V primitives, TN_{EXT} and BSPN are probably the only ones that have significant practical usefulness in modelling and representing parallel systems. (MCW)

10445 (RISO-M-1745) GENERAL PURPOSE SYNTAX ANALYSER/TRANSLATOR. Taylor, J. R. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sep 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

A simple table driven syntax analyzer is described, which uses a top down single track analysis algorithm. The analyzer is written in a dialect of LISP and runs on an 8K-word PDP-8 computer. The analyzer is intended as the first stage of data input to several different programs used for simulation and reliability analysis. The output of the program is a form of reverse polish code. (auth)

10446 (SAND-74-0097) EXTENSIONS AND REVISIONS FOR THE NASA-AMES AND GAS-NAS FLOW FIELD CODES. Eaton, R. R.; Larson, E. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1974. Contract AT(29-1)-789. 51p. Dep. NTIS $5.75.

The NASA-Ames and GAS-NAS flow field codes were improved in four areas. These codes are now modified to calculate coefficients of drag and flow over long bodies. The results can be plotted and the codes can be applied to a wider range of body geometries. (auth)

10447 (SAND-74-0362) ANALYSIS OF THE LATERAL MOTION OF AN UNBALANCED PROJECTILE IN AN ELASTIC GUN TUBE. Perdreauville, F. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1974. Contract AT(29-1)-789. 42p. Dep. NTIS $5.25.

An artillery projectile that is balloting in a flexible gun tube is considered. Equations of motion for the projectile and barrel are derived, where the barrel motion is described in modal form. Forces and moments that affect the motion of projectile and barrel are discussed, and kinematic relations are derived. (auth)

10448 (SAND-74-5570) INTERACTIVE GRAPHICS AIDED STRUCTURAL ANALYSIS. Biffle, J. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 5p. (CONF-741001-26). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Finite element structural analysis computer programs can only be used effectively when the input can be accurately checked and the output correctly examined. The paper discusses several ways the input data can be examined with the use of a cathode ray tube, a mini-computer, and the CDC 6600 computer. The analyst can generate either two-dimensional or three-dimensional plots, see the results as soon as they are generated, correct mistakes, and then regenerate. A large amount of time can be saved by using an interactive computer graphics system. Examining three-dimensional objects is made practical by rotation of the object and hidden line removal. Interactive graphical output processing is especially necessary with three-dimensional structures because the object needs to be rotated to a desired orientation, sliced with a plane, and contours of a variable plotted on the plane. (auth)

10449 (SAND-74-8666) ANALYSIS OF THREE-DIMENSIONAL, INVISCID FLOW FIELDS BY APPLICATION OF SHOCK CAPTURING TECHNIQUES. Sanders, B. R.; Dwyer, H. A. (Sandia Labs., Livermore, Calif. (USA)). Nov 1974. Contract AT(29-1)-789. 16p. (CONF-741001-29). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

A method is described for solving the steady, three-dimensional gas dynamic equations for supersonic flow over arbitrary body shapes. The method is much less complex to apply than the method-of-characteristics, but the accuracy is comparable. The hyperbolic set of partial differential equations is integrated by applying an explicit, second-order accurate, predictor-corrector finite difference technique in three-space dimensions. The gas dynamic equations are solved in conservation variable form that allows flow field discontinuities, such as shock waves and contact surfaces, to appear automatically in the numerical solution. A nonorthogonal coordinate transformation is applied to the differential equations to improve numerical accuracy while minimizing computational time and storage. The inviscid solid wall boundary conditions are handled in a special manner that is more consistent with the differential equation system than commonly used techniques. The overall accuracy in calculating three-dimensional flows is demonstrated by comparing the solutions for cones at angles of attack with previous cone solutions from the literature. The flow field results for an ogive-cylinder body is also shown. (auth)

10450 (UCRL-51673) COMPUTER MODEL FOR WAVE PROPAGATION IN POROUS MATERIALS. Ree, F. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Oct 1974. Contract W-7405-eng-48. 22p. Dep. NTIS $4.00.

A mathematical model that describes the dynamical response of porous materials is presented. Based on Holt's P-α-τ model, it allows for an elastic change in porosity. It also includes the deviatoric stresses and an option for a porosity-dependent relaxation time for pore closure. A computer subroutine which uses this model as a constitutive relation in the KO hydrocode is described in detail. Two examples of stress-wave propagation in a porous medium are presented. (auth)

10451 (UCRL-75853) MEASURES OF IMPORTANCE OF EVENTS AND CUT SETS IN FAULT TREES. Lambert, H. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Oct 1974. 33p. (CONF-740906-5). Dep. NTIS $4.75.

From conference on reliability and fault tree analysis; Berkeley, California, USA (3 Sep 1974).

A survey of the available methods that quantitatively rank basic events and cut sets according to their importance is presented. Such a ranking permits identification of events and cut sets that significantly contribute to the occurrence of the top event. Time-dependent behavior of each method is shown, assuming proportional hazard rates and unrepairable components. A method is presented to compute the importance of events in which repair is permitted. The practical application of importance measures in upgrading system designs and generating checklists for system diagnosis is considered. (auth)

10452 (UCRL-76044) SAMPLE FILE CONTROL FOR THE AUTOMATED LABORATORY. Bystroff, R. I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Oct 1974. 15p. (CONF-741038-1). Dep. NTIS $4.00.

From office of research and development ADP workshop; Bethany, West Virginia, USA (2 Oct 1974).

Sample file control is an integral part of each laboratory minicomputer system that is currently being implemented for several EPA laboratories. Examples will be taken from the Region V Central Regional Laboratory System. With modifications, this sample file control system will apply to the other laboratories. (auth)

10453 (UCRL-76084) COMPUTER PROGRAMS FOR SIMULATING PHYSICAL PHENOMENA IN THREE SPACE DIMENSIONS AND TIME. Grantham, P.; Cronshagen, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Oct 1974. 9p. (CONF-741001-28). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Details are given for a package of versatile computer programs that model complex physical phenomena in three dimensions and in time. Numerical techniques used in the coding are explained, as well as the basics of program operation for all codes. Some numerical results are given to illustrate typical applications. (auth)

10454 (Y-1962) PROCEDURE FOR USING MULTIVARIATE NORMAL TOLERANCE REGIONS FOR THE CERTIFICATION OF RELATED CHARACTERISTICS. Holland, C. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). Dec 1974. Contract W-7405-eng-26. 84p. Dep. NTIS $7.25.

The investigation develops a complete procedure for the use of multivariate normal tolerance regions for the simultaneous certification of up to 30 related characteristics. A Monte Carlo integration technique was developed to investigate the accuracy of an approximation to the multivariate normal tolerance region. The results indicated that the approximation is sufficiently accurate for relatively small sample sizes. (auth)

Miscellaneous

10455 (CEA-CONF-2699) MEASUREMENT OF CONCENTRATION OF SO_2 BY A DRY SUPPORT METHOD. Diffusion of SO_2 in the Atmosphere. Archimbaud, M.; Brun, J.; Perez, L. (CEA Centre de Pierrelatte, 26 (France)). 1974. 17p. (In French). (CONF-740567-1). Dep. NTIS (US Sales Only) $4.00.

From international colloquium on polluted atmospheres; Paris, France (8 May 1974).

A method for the trapping of atmospheric SO_2 on a dry support and its spectrocalorimetric determination is described. The method is compared with other methods currently in use for the measurement of the pollution level. This method is perfectly adapted to in situ measurements and can be used in pollution control. Some examples are described, chiefly in cases where the method is associated with the technique of simulation of tracing the diffusion of pollution materials in the atmosphere. (tr-auth)

10456 (JINR-E2-8149) PROPERTIES OF THE ALGEBRAS $L^+(D)$. Uhlmann, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

Properties of the algebra of all operators which together with its adjoints transform a given dense linear manifold of an Hilbert space into itself are considered. This algebra admits inner *-automorphisms and derivations only and there is an algebraic characterization of this algebra. (auth)

10457 (LA-5774-MS) FERMAT FUNCTIONS AND THE GENERAL WALLIS PRODUCT. Everett, C. J.; Stein, P. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1974. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

A general factorial $f(a,p,n) = a(a + p) \dots [a + (n - 1)p]$ is defined for $a, p > 0$, $n = 1, 2, 3, \dots$, and shown to have the asymptotic form $f(a,p,n) \sim (2\pi n)^{1/2} (n/e)^n n^{a/p-1} p^n/\Gamma(a/p)$. The corresponding Wallis product, $W(a,p,n) = \{f(a,p,n)\Gamma(a/p)/f(a + 1,p,n) \Gamma[(a + 1)/p]\}^p[n - 1 + (a + 1)/p]$, is then found to satisfy the relation $[a + np - (p - 1)]/(a + np) < W(a,p,n) < 1$ for integral $p \geq 2$. This is proved by exploiting the properties of a two-parameter family $F(a,p)$ of "Fermat functions" $S(\theta)$, $C(\theta)$. When $a = 1$, $p = 2$, one has $S(\theta) = \sin\theta$, $C(\theta) = \cos\theta$, and obtains the classical Wallis inequality $2n/(2n + 1) < W_n < 1$, where $W_n = [(2n - 1)!!/(2n)!!]^2 \pi n$. (auth)

10458 (NP-20192) POTENTIALLY AVAILABLE FACILITIES AT THE NATIONAL REACTOR TESTING STATION. Fast, E. (comp.). (Eastern Idaho Nuclear Industrial Council (USA)). Feb 1970. 82p.

A survey of facilities at the Atomic Energy Commission's National Reactor Testing Station in Idaho which are currently unused or potentially available for other uses indicates that there are 14 facilities (as of February 1, 1970) offering 20 different buildings and a total floor space of over 223,000 square feet. Although the original uses of these facilities were of a very specialized nature, they offer an opportunity to expand the industrial output of this area in many and unique ways. The original mission of these facilities included such diverse assignments as a nuclear powered aircraft with its large "hangar", the first nuclear electrical power plant, various power reactor concepts for army and civilian use, and reactors subjected to extreme power excursions in safety testing. Basic information on the facilities is presented for the benefit of any other government or private organizations who might wish to put the available facilities to maximum use. (auth)

10459 (ORNL-4989) MATHEMATICS AND STATISTICS RESEARCH DEPARTMENT PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1974. Coveyou, R. R.; Gosslee, D. G.; Upuluri, V. R. R. (Oak Ridge National Lab., Tenn. (USA)). Dec 1974. Contract W-7405-eng-26. 59p. Dep. NTIS $5.45.

Research in mathematics and statistics is summarized. Consulting and collaboration is also performed in biology and medicine, environmental sciences, urban, materials, and thermonuclear research, management problems, and programming. A list of publications is included. (JFP)

Chemistry

10460 (CONF-741023-3) MONITORING OF AN ATOMIC ABSORPTION SPECTROPHOTOMETER USING CUMULATIVE SUM STATISTICAL CONTROL CHARTS. Montgomery, J. R. (Puerto Rico Nuclear Center, Mayaguez). 1973. Contract AT(40-1)-1833. 17p. Dep. NTIS $4.00.

From 7th materials research symposium; Gaithersburg, Maryland, USA (7 Oct 1974).

A method was devised to monitor the reproducibility of an atomic absorption spectrophotometer utilizing statistical control charts. Standard curves for 5 elements, Cu, Pb, Zn, Mn, and Cd, were monitored to determine if the cumulative sum type control charts with "V" mask can detect incipient changes in sensitivity of the atomic absorption spectrophotometer caused by alteration in lamp output, fuel, air mixtures, and electronic gear. The cumulative sum chart is easily computed and allows the operator to quickly detect significant changes in the sensitivity of the machine. (auth)

Life Sciences

10461 (COO-1314-30) COMPARATIVE MUTAGENESIS. Progress Report, September 15, 1972–September 14, 1973. Brockman, H. E. (Illinois State Univ., Normal (USA)). 1974. Contract AT(11-1)-1314. 32p. Dep. NTIS $4.75.

The lethal and mutagenic activities of ICR-170 are greater in the presence of N_2 or He than in the presence of O_2 in Neurospora crassa; hence, this phenomenon is termed the anoxia effect. The effect with ICR-170 at the ad-3 region of N. crassa has been observed for forward mutation and for reversion of presumptive frameshift and base-pair substitution mutants. The anoxia effect is not observed with the alkylating agents EMS and PL, but it is noted with other ICR-compounds structurally related to ICR-170. The anoxia effect is not due to increased permeability of the conidia to ICR-170. ICR-170 has a remarkable ability to cause increased mutation at low concentrations and at 100% survival. The anoxia effect has also been observed for ICR-170 in Saccharomyces cerevisiae. Three carcinogens that, like ICR-170, are reactive intercalators are potent mutagens in certain presumptive frameshift mutants of S. cerevisiae. The induction of petites by ICR-170 in ascospores of S. cerevisiae is dependent on the stage of germination, and all of these petites are cytoplasmic. A pleiotropic, temperature-sensitive mutant of S. cerevisiae has been characterized as a cell-cycle mutant. The ultrastructure of ascospores from macro and microconidiating strains of N. crassa is different. (auth)

10462 (LA-5734-SR) SCRAPIE HISTOLOGY IMAGE ENHANCEMENT. Seagrave, J. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1974. Contract W-7405-eng-36. 15p. Dep. NTIS $4.00.

Pseudocolor television image-enhancement and optical-density analysis techniques were applied to recognition and characterization of vacuolated neurons in scrapie-infected and autolytic sheep brain histological sections. The variability of vacuolization was found to preclude direct application of the technique to automated processing. It is recommended that further effort be applied to using the technique for automatic statistical evaluation of the degree of proliferation of astrocytes (astrogliosis) in specimens stained to reveal that component. Coherent optical techniques are discussed that appear applicable to the simultaneous quantification of vacuolization and astrogliosis in thick specimens. (auth)

10463 (LA-UR-74-1393) PREPARATIVE METHODS FOR ANALYSIS OF DNA, PROTEIN, AND NUCLEAR-TO-CYTOPLASMIC RATIOS IN NORMAL AND TUMOR CELL POPULATIONS. Crissman, H. A.; Steinkamp, J. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 31p. (CONF-740954-1). Dep. NTIS $4.75.

From pulse-cytophotometry international symposium on automated cytofluorometry with special reference to methodology, cancer-screening and leukemia; Nijmegen, Netherlands (18 Sep 1974).

10464 (LBL-3300) BIOCHEMICAL AND PHYSICAL STUDIES OF RIBULOSE 1,5-DIPHOSPHATE CARBOXYLASE FROM SPINACH LEAVES. Chu, D. K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1974. 80p. Dep. NTIS $7.00.

Thesis.

10465 (ORO-3894-16) PHOTOELECTRON EMISSION IN ORGANIC THIN FILMS. Final Report, January 1, 1973–December 31, 1973. Jarnagin, R. C. (North Carolina Univ., Chapel Hill (USA). Dept. of Chemistry). 1973. Contract AT (40-1)-3894. 6p. Dep. NTIS $4.00.

The release and penetration of low energy electrons (0-2 eV) within the interior of hydrocarbons and similar media were studied. Electrons in this range of subexcitation energy (electronic excitation) are released through photoelectron ejection from molecular sites contained as solutes in dielectric fluids, thin lipid membranes, and surface coatings. They are also generated during the thermalization of secondary electrons subsequent to irradiation by high energy particles of all types. The experimental approach was to fabricate thin films of organic substances upon photoemitting surfaces and to measure the energy distribution of the electrons emitted from the underlying substrate through the organic overlayer. To achieve these ends a photoelectron spectrometer was designed and constructed. Some results relating to energy loss mechanisms by electrons initially with 0 to 2 eV of kinetic energy are obtained with hydrocarbons and alkyl silane films whose thickness was between 1 and 100 molecular layers. (MCW)

10466 (UCID-16101) MULTI-CASUALTY MEDICAL EXERCISE. Dutra, J. A.; Burklin, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Aug 1972. Contract W-7405-eng-48. 21p. Dep. NTIS $4.25.

A special exercise was developed to test the ability of a medical department to respond to an emergency involving numerous casualties. The incident assumes the occurrence of an explosion during a chemical experiment conducted as part of a training program for summer students. (auth)

10467 (UR-3490-594) PRESENCE OF A SOLUBLE "REGULATOR" PHASE (SECONDARY CALCIUM PHOSPHATE) IN BONE. Neuman, W. F. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1974. Contract AT(11-1)-3490. 14p. (CONF-740736-1). Dep. NTIS $4.00.

From 5th international symposium on parathyroid physiology; Oxford, UK (22 Jul 1974).

On a moment to moment basis, serum calcium levels are regulated by the balance of fluxes to and from the skeleton. It is readily conceded that calcium balance is determined by intestinal inflow and renal outflow. Some membrane function is an important feature in the control of these fluxes in bone, particularly in young growing bone. The membrane function exerts a direct control on levels of K^+ in bone (probably also Na^+ and possibly H^+) and, through metabolic production of acid, an indirect control on Ca^{++} and Pi. The indirect control of Ca^{++} and Pi involves, in part, the acid stabilization of some amorphous phase having a solubility characteristic of $CaHPO_4$. (auth)

Materials

10468 (EUR-5195f) POLLUTION PROBLEMS ASSOCIATED WITH THE PRODUCTION OF TITANIUM DIOXIDE. (Commission of the European Communities, Luxembourg). Sep 1974. 357p. (In French). Dep. NTIS (US Sales Only) $21.00. EUR B. Fr. 500.-.

The situation of the titanium dioxide industry in the EEC, facing its effluent problems, is explained. Analyzing the technical and economical aspects of that question has required taking into consideration: the titanium dioxide industry in the EEC: processes, producers and productions, present effluents; the present and foreseeable situation of raw materials and the future of beneficiated ores; then: a model allowing an evaluation of qualities and nature of effluents, corresponding to a given raw material; and potentially promising processes for effluent treatment (at least partial). Finally, based on those various factors, feasible treatment systems for improving today's effluents are proposed. In each case, capital and operating costs are indicated, as well as expected performance and problems still unsolved. (tr-auth)

10469 (LBL-3107) EFFECT OF PROCESSING ON MICROSTRUCTURE AND MECHANICAL BEHAVIOR OF MAGNESIUM OXIDE. Sweeting, T. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1974. Contract W-7405-eng-48. 61p. Dep. NTIS $6.25.

Thesis.

Specimens of polycrystalline MgO were fabricated from two different MgO powders by hot pressing in graphite and alumina dies, followed by annealing in air, vacuum, or within the graphite die in vacuum. The two powders were prepared by dispersing in isopropanol, drying, and milling in a rubber-lined mill with alumina balls. The relatively high cation content, particularly Ca and Si, in Type II MgO was the most significant difference in the two powders as it led to the formation of a small amount of liquid phase along the grain boundaries during the annealing step at 1550°C. Impurities introduced and modified throughout the entire processing procedure of powder preparation, pressing in a graphite die, and annealing in different ambient atmospheres resulted in microstructures with varying grain size and grain boundary structure in the specimens produced from Type I MgO. The formation of a liquid phase in the Type II MgO specimens tended to eliminate the effect of these processing variables but led to the development of grain sizes two or three times larger in size. Correlations of the microstructures of the specimens were made with their mechanical behavior in compression at a constant strain rate at 1200°C. (auth)

10470 (LBL-3176) PHASE TRANSFORMATIONS IN ORDERED, SPINODAL Cu-Mn-Al ALLOYS. Okada, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1974. Contract W-7405-eng-48. 62p. Dep. NTIS $6.25.

Thesis.

Alloys along the composition line Cu_3Al-Cu_2MnAl decompose spinodally into a Cu_2MnAl rich phase and a Cu_3Al rich phase during aging at temperatures below 350°C. Hot stage electron microscopy was applied to determine the miscibility gap temperatures of the alloys by monitoring the disappearance of satellites in the diffraction mode and structure modulation in the image mode. The antiphase domain boundaries (APB's) developed during aging inside the miscibility gap were found to inherit the same character as those above the miscibility gap. The new phase (the γ' phase) appearing in the spinodally decomposed Cu-Al rich phase was found to have an orthorhombic lattice with two layer stacking sequence (2H), which is considered to be formed by a shear along (110) planes of the parent β_1-lattice (DO_3). The Cu-12.4% Al-4.68% Mn alloy that is almost at the edge of the miscibility gap shows that slower quenching yields large amounts of γ' plates (martensite). This observation is in good agreement with that of the γ' phase in the Cu-Al rich phase, because the furnace cooled $Cu_{2.5}Mn_{0.5}Al$ alloy also gives a high density of γ' phase in the Cu-Al rich phase. (auth)

10471 (LBL-3179) THEORETICAL AND EXPERIMENTAL ANALYSIS OF CRYSTAL DEFECTS WITH PARTICULAR EMPHASIS TO SILICON. Chen, L. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1974. Contract W-7405-eng-48. 72p. Dep. NTIS $6.75.

Thesis.

Electron micrographs obtained at high voltages and computed defect image intensity profiles (by solving many-beam dynamical equations of the theory of electron diffraction contrast) were used to determine the best imaging conditions for small loops and closely spaced dislocation dipoles in systematic reflection conditions. In the first example, it is shown how the nature of stacking faults (intrinsic or extrinsic) can be found from the contrast of dark field images formed in lg when the 2g systematic condition is satisfied. In the second example, further exploration is made of the improved resolution that can be obtained for diffraction contrast at defects such as dislocations by lowering the effective extinction distance, e.g. by dark field weak-beam, or bright field high order reflection, imaging. The methods were applied to defects in boron-implanted silicon in which for the first time, dissociated loops were resolved. The intrinsic stacking fault energies of four diamond cubic structure elements and eleven zinc blende structure compounds were calculated by the pseudopotential method to second order perturbation approximation. (MCW)

10472 (MHSMP–74-16) DRIVER SUBASSEMBLY EXPLOSIVE TRAIN MODIFICATION. Final Report. Slape, R. J.; Hanes, L. D.; VanVelkinburgh, J. H. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Aug 1974. Contract DA-11-173-AMC-487(A). 18p. Dep. NTIS $4.00.

An evaluation of three separate explosive system modifications with respect to the standard LX-13/Tetryl explosive system presently employed in driver subassemblies was made. Each of the modified drivers were to be tested using the Manganin gage for peak pressure measurements and the electromagnetic velocity gage for peak pressure and pressure profile measurements. The modifications to the driver explosive system to be tested were given. The Tetryl output pellet was replaced with a PETN pellet of such a density as to provide an output pressure equivalent to that produced by Tetryl at a density of 1600 kg/m^3 within ± 0.1 GPa. The Tetryl output pellet was replaced with an RDX/binder pellet of such a composition and density to again provide an output pressure equivalent to Tetryl within ±0.1 GPa. The same PETN output pellet developed above was used and a closed-end steel tube was added to the input end of the stainless steel driver. This tube was to be loaded, as was the cone area, with LX-13. (auth)

10473 (SAND–74-0176) THERMAL ANALYSES OF THE TATER (TALOS-TERRIER-RECRUIT) TEST VEHICLE GRAPHITE NOSETIP, FLARE, AND FINS. Beard, S. G.; Carnicom, M. L.; McAlees, S.; Randall, D. E.; Hochrein, G. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1974. Contract AT(29-1)-789. 53p. Dep. NTIS $5.75.

The preflight aerodynamic heating, thermal, and ablation analyses of an ATJ-S graphite nosetip, the Recruit flare, and the Terrier fins of the Talos-Terrier-Recruit (TATER) flight test vehicle are presented. The results of the analyses indicate that the designs of these components are adequate for the environments considered. Comparisons of predicted temperatures and recession with the limited flight data available are also made. The derivation of a thermochemical heat of ablation for the low-temperature ablator, Sparesyl, is also presented. (auth)

10474 (SAND–74-0219) EVALUATION OF AMALGAMATED METALLIC SURFACES FOR REDUCING FRICTION, CONTACT RESISTANCE, AND WEAR IN ELECTRICAL CONTACT APPLICATIONS. Cuthrell, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1974. Contract AT(29-1)-789. 32p. Dep. NTIS $4.75.

Mercury wetting of metallic surfaces is insufficient to reduce friction, whereas the amalgamation of certain metals to form a mercury rich solid layer at the surface significantly reduces friction, contact resistance, and wear. The amalgamation of metal alloys results in considerably lower friction than the amalgamation of the constituent metals separately. Coefficients of friction for eleven amalgamated metals and four alloys are presented. Laser interference fringe surface topography, contact resistance, coefficients of friction during 1 km of wipe, the associated wear, and the effects of temperature on friction are reported for an amalgamated palladium–silver alloy. (auth)

10475 (SAND–74-0249) ORGANIC HYDROGEN GETTERS. Certification Study on the DPPE-5%Pd–$CaCO_3$ Hydrogen Getter System: a Progress Report. Courtney, R. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT (29-1)-789. 25p. Dep. NTIS $4.50.

The getter formulation consists of 1,6-diphenoxy-2,4-hexadiyne coated onto 5%Pd–$CaCO_3$. Due to the interest in the hydrogen getter, a certification program was established between Sandia, Los Alamos (WX-2), and Union Carbide (Y-12 Plant) to learn as much as possible about the getter material in order to have it certified (or not certified) for use in closed systems. The progress of Sandia's involvement in the hydrogen getter certification program is discussed. (auth)

10476 (Y-1957) ORTHOTROPIC PHOTOELASTICITY FOR FIBER-REINFORCED COMPOSITE MATERIALS. Knight, C. E. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 22 Nov 1974. Contract W-7405-eng-26. 92p. Dep. NTIS $5.45.

This study was concerned with the development of orthotropic photoelasticity as a viable means of experimentally analyzing the stresses in orthotropic material structures. Theoretical formulation of the governing equations and verification experiments for the theory were investigated. Material with sufficient transparency and uniformity was prepared. Theoretical relationships were derived by utilizing the tensorial nature of stress, strain, and birefringence in the material. The relations were condensed to provide the equations needed for plane-stress analysis. Experiments were carried out on special biaxial stress fields created in off-axis, uniaxial, tensile-stress specimens. Material properties were determined experimentally and calculated from a microstructure finite-element model. The experiments conducted support the theoretical orthotropic photoelasticity formulation. A plane-stress problem solution by orthotropic photoelasticity showed good correlation with finite-element and elasticity solutions. A model material of fiberglass and epoxy was produced with a low void content and matched refractive indexes to give adequate transparency. Material properties were reasonably predictable from the microstructure model. (auth)

Physics and Engineering

10477 (CEA-CONF-2655) HIGH SENSITIVITY DIFFERENTIAL MAGNETOMETER FOR ARCHAEOLOGICAL PROSPECTION. Lemercier, D.; Lemercier, P.; Robach, F.; Salvi, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 11 Apr 1974. 22p. (CONF-740352-1). Dep. NTIS (US Sales Only) $4.25.

From symposium on archaeometry and archaeological prospection; Oxford, UK (20 Mar 1974).

The application of the double resonance magnetometer in archaeology and its characteristics are described. The magnetometer must be capable of eliminating the effects of the small magnetic anomalies of the Earth's magnetic field and to eliminate surface noises. (MCW)

10478 (COO–2430-1) ANALYSIS OF "ECHO SOUNDING" DATA NORTH-CENTRAL PACIFIC. Progress Report, February 1, 1974–October 15, 1974. Hayes, D. E. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory). 1974. Contract AT(11-1)-2430. 16p. Dep. NTIS $4.00.

Echograms and seismic profiler records were examined in the area bounded by 29°N and 31°N; 156°W and 160°W. Total sediment thicknesses are thin and uniform north of the Murray fracture zone but both bottom relief and sediment disposition are variable within the fracture zone province. A bottom pinger operating at 3.5 kHz was built and tested preliminarily. The instrument promises to be most useful in delineating the nature of micro-relief and the acoustic properties of the uppermost sediments ($\sim$100m) in areas of deep water. Three-dimensional perspective views of the seafloor relief were generated using computers and provides a graphic illustration of the physiography in the study area. (auth)

10479 (KFK–1954) INVESTIGATIONS ON METHODS TO DETERMINE THE PHONON DENSITY OF STATES WITH APPLICATION TO THE ELEMENTS OF THE FIFTH GROUP OF THE PERIODIC TABLE. Salgado, J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Aug 1974. 83p. (In German). Dep. NTIS (US Sales Only) $7.25.

Thesis. Submitted to Karlsruhe Univ. (TH) (West Germany). Fakultaet fuer Physik.

Using a new method based on the inelastic coherent scattering of neutrons in polycrystalline materials the phonon densities of states of arsenic, antimony, and bismuth were measured. The results confirm the expected similarity of the chemical binding of these elements with A7-structure. The density of states of the crystalline is compared with the amorphous modification of arsenic and bismuth and the differences are discussed. The phonon densities of states of antimony and bismuth computed from the experimental dispersion curves show large deviations from those directly measured. The lattice contribution to the specific heat was calculated using the measured densities of states. (tr-auth)

10480 (LBL-3400) X-RAY PHOTOEMISSION AND SURFACE STRUCTURE. Shirley, D. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1974. Contract W-7405-eng-48. 31p. (CONF-741015-7). Dep. NTIS $4.75.

From 21st national symposium of the American Vacuum Society; Anaheim, California, USA (19 Oct 1974).

X-ray photoemission spectroscopy (XPS) is a "semisurface" technique that can be modified to study bulk properties, surfaces, or adsorbed species. As a bulk probe it is capable of yielding band-structure information. It can distinguish amorphous from crystalline materials and is sensitive to magnetic and spatial order. Sensitivity to surface character per se is less pronounced. Relaxation effects are prominent in XPS spectra. Core-level binding energies of adsorbed species yield structural information if relaxation is considered. The same should be true for valence orbitals. Heterogeneous catalysis can be understood in a general sense as arising from the same origins as the relaxation energies in photoemission. (auth)

10481 (NVO-38-32) DEEP HOLE DRILLING FEASIBILITY STUDY. (Fenix and Scisson, Inc., Tulsa, Okla. (USA)). May 1969. 106p. Dep. NTIS $5.45.

It is feasible to drill a hole to a depth of 50,000 feet by utilizing conventional rotary drilling equipment and techniques. Existing equipment is capable of drilling the hole but modifications of some equipment items are warranted for completion of the lower portion of the hole. The hole could be started with presently available equipment as soon as funds are available, a location established, and a contractor selected. While the upper portion of the hole (20,000 to 30,000 ft.) is being drilled, equipment modifications could be made and supplemental equipment developed. This would allow time to make the equipment available when needed for the lower portion of the hole. Two locations are considered as established by the criteria, both in the Coast Ranges Province of California in the vicinity of the San Andreas Fault. One location would be in an area where granitic rock outcrops at the surface while the other would be in an area where the granitic rock is overlain by 10,000 feet of sediments. The estimated time to drill the hole under ideal conditions at either location is 4-3/4 years at an estimated cost of $20,000,000. (auth)

10482 (SAND-74-0215) HOLOGRAPHIC AND DIRECT OPTICAL DATA STORAGE AT SANDIA LABORATORIES. Hessel, K. R.; Stalker, K. T. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 20p. Dep. NTIS $4.00.

To show the feasibility of several high density optical data storage proposals work has been done with both holographic and direct optical storage subsystems. Fiber optics ribbons were proposed to direct light to and from linear ferroelectric page composers and results are presented. One-dimensional holographic recording is demonstrated to be an attractive alternative to conventional two-dimensional holography and is also compatible with the use of fiber optics light guides in high data rate systems. It is also feasible to record data directly by modulating light emitting diode (LED) arrays. Optical fiber coupling between the individual LED's and the recording material may be advantageous. Crosstalk, coupling, and fiber losses normally are not a problem. Using LED arrays and film sensitivities now commercially available, it is feasible to attain line widths between 3 and 20 microns, or wider, and bandwidths up to 250 kHz/channel. (auth)

10483 (SAND-74-0266) ELECTROMAGNETIC FIELDS VERY NEAR TO A MONOPOLE ANTENNA. Halbgewachs, R. D.; Chang, D. C.; Harrison, C. W. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1974. Contract AT(29-1)-789. 115p. Dep. NTIS $8.75.

The near-zone field components $2\pi\rho\,|H_\phi(\rho;z)|$, $2\pi\rho\,|E_\rho(\rho;z)|$, and $(2\pi/\beta)\,|E_z(\rho;z)|$ are determined numerically for a monopole of length h and radius a erected vertically over a perfectly conducting half-space of infinite extent. Curves are supplied for the field under the following conditions: (a) $\beta h = \pi/2$, $\Omega = 2\ln(2h/a) = 8.531$, $a/\lambda_o = 7.022 \times 10^{-3}$, $1.01 \le \rho/a \le 100$, $0 \le z \le h$ and (b) $\beta h = \pi$, $\Omega = 9.917$, $1.01 \le \rho/a \le 100$, $0 \le z \le h$. Here $\beta = 2\pi/\lambda_o$ is the free space propagation constant. Unit voltage is applied to the base of the monopole by means of a coaxial cable having a characteristic impedance of $Z_c = 50$ ohms. Solution of this problem and the resultant data may be used as a basis for constructing a standard field source for instrument calibration in the communication frequency range. The theory also predicts the radiation level near a monopole for biological hazard evaluations. (auth)

10484 (SAND-74-5458) TRANSIENT PULSE TESTING OF ELECTROEXPLOSIVE DEVICES. Steele, B. R.; Strasburg, A. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). 23 Sep 1974. 10p. (CONF-741044-1). Dep. NTIS $4.00.

From annual meeting on pyrotechnics and explosives systems in transitions; St. Louis, Missouri, USA (2 Oct 1974).

Nondestructive testing of an explosive device is reported using transient electric pulses. Electrothermal response data are obtained from the thermal-follow bridge and the transient pulse. Both methods indicate thermal capacity and thermal conductivity of the bridgewire/explosive interface. Both methods use a bridge network to separate the electrothermal response from the electrical response of the cold resistance. The thermal-follow bridge uses a sinusoidal input signal and the transient pulse a square-wave input signal. Use of the transient pulse can reduce ultimate production cost. (MCW)

10485 (SLA-73-1084) ENVIRONMENTAL TESTING OF SOLDERED RF HYBRID MICROCIRCUITS. Olson, H. C.; Knauss, G. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 35p. Dep. NTIS $4.75.

Thirty-six soldered hybrid microcircuits (HMC's) were subjected to thermal and mechanical environments representative of those proposed for a new radar program. The HMC's were built with approximately 60K angstroms of gold metallization and had applique parts (chip and variable capacitors, dummy transistors) attached to the gold metallization using 50 wt% lead-indium solder. Heat sinks or mounting plates were also attached to the underside of the HMC's with a four-thousandths-inch-thick solder preform of the same length and width as the HMC substrate. Results from the environmental test program indicate that solder attachment of applique devices to thin gold films will provide sound, reliable hybrid microcircuits. (auth)

10486 (SLA-74-0268) SCDS RELIABILITY/MAINTAINABILITY PROGRAM PLAN (CDRL ITEM 19). (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1974. Contract AT(29-2)-2172. 43p. Dep. NTIS $5.25.

The Program Plan identifies and delineates the tasks, sources, organization, interfaces, requirements, schedules, reports to be submitted, and control features of the reliability and maintainability portions of the Base and Installation Security System (BISS) research and development effort. The plan was developed to ensure that BISS reliability and maintainability requirements will be accomplished and achieved in a timely and effective manner and will be the primary reference and guide for implementation of the tasks. (MCW)

10487 (UCRL-51677) SOFT ARMOR TEST MATRIX 1: FINAL REPORT. Honodel, C. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Sep 1974. Contract W-7405-eng-48. 36p. Dep. NTIS $4.00.

The test series utilized LLL experimental facilities and diagnostic techniques for the determination and demonstration of the systematic nature of soft body armor corresponding to variations in the armor design and testing parameters. The armor material was composed of DuPont "Kevlar-29" polyamide strands which were woven into a basketweave, 400 denier cloth. (auth)

10488 (UCRL-51693) STUDY OF A NEW ANTENNA SOURCE MODEL. Adams, R. W.; Poggio, A. J.; Miller, E. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Oct 1974. Contract W-7405-eng-48. 4p. Dep. NTIS $4.00.

A new antenna source model for the GIANT-MKIIIC(WF-MBA/LLL2A) thin-wire code is presented. This model depends upon an explicit current-slope discontinuity and leads to well-behaved antenna input impedances and highly localized fields in the source region. (auth)

10489 (UCRL-75897) ANALYSIS OF IN-CLOUD SCAVENGING EFFICIENCIES. Williams, A. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1974. 25p. (CONF-741003-5). Dep NTIS $4.25.

From precipitation scavenging conference; Champaign, Illinois, USA (13 Oct 1974).

Aerosol particles incorporated into raindrops can be scavenged by means of a raindrop-particle interaction as must be the case for below-cloud scavenging. Another less direct but possibly more efficient means of particle removal is through the incorporation of particles into cloud droplets followed by the subsequent removal of the particle-laden droplets through collision with raindrops. This two stage process appears to dominate the in-cloud scavenging at least for some particle sizes. Values are calculated of the particle-droplet removal rate, since this appears to be the limiting rate for a wide range of particle sizes. The calculation proceeds by finding solutions for the convective diffusion equation. The scavenging mechanisms studied within this framework are Brownian diffusion, turbulent diffusion, diffusiophoresis, thermophoresis, Coulomb interaction for both charged particles and droplets, and the charge-dipole interaction for a charged particle and a droplet polarized by an external electric field. Limits for nucleation scavenging are studied, but this mechanism does not permit description by the convective diffusion equation. MCW

10490 (UR-3490-600) INFLUENCE OF VISCOUS INTERACTION IN THE DIFFUSIONAL DEPOSITION OF PARTICLES. Dahneke, B. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1974. 23p. (CONF-741039-1). Dep. NTIS $4.25.

From symposium on dynamics of aerosols: theory and applications; Ottawa, Canada (20 Oct 1974).

The influence of viscous interaction in preventing or retarding diffusional deposition of fluid-borne particles and droplets onto a collecting surface may have significant effect on many basic phenomena in colloid and aerosol physics and chemistry, such as coagulation, filtration, and sampling. Claims that deposition of aerosols by pure Brownian diffusion is prevented by a compressed gas layer and that the compressed gas layer is not important or, at least, does not prevent deposition are made. No quantitative results have appeared that serve to demonstrate the importance of viscous interaction. The results of a theoretical investigation of the influence of viscous interaction on diffusive deposition of particles in gaseous and liquid media and the influence of electrical double layers in liquid media are considered. (auth)

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